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VOLUME I.

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1884 - 1889  
(INCLUSIVE.)

*First volume of Engineering Index*



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## PREFACE.

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The material composing this volume has appeared in the monthly numbers of the JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES since October 1884, under the title of "*Index Notes*." The notes published in the twelve numbers of one year have been republished, with cross-references, arranged in one alphabetical list, in an appendix to each volume. Seven of these annual summaries are now brought together, rearranged alphabetically, with numerous cross-references, and with a more systematic arrangement of subject matter. It is published by the Board of Managers of the JOURNAL and placed on sale at a price barely sufficient to pay the cost of arrangement and publication.

Although there are over eleven (11) thousand notes and cross-references in this list, no claim is made for its completeness, even for the period covered by it. It is thought to contain, however, nearly all periodical, society, and fragmentary matter of permanent value not only for the period 1884 to 1891, inclusive, but a great deal which appeared earlier. Thus the entire proceedings of the *American Society of Civil Engineers*, of the *American Society of Mechanical Engineers*, and of the *Association of Engineering Societies*, have been indexed so far as they seemed deserving. Also the complete files of *Van Nostrand's Engineering Magazine*, and of *The Engineering News*. The *Proceedings of the Institution of Civil*

#### IV

*Engineers* are here indexed only for the period covered for the current literature, viz: 1884—1891 inclusive. A complete index of these proceedings is issued every few years by the Institution.

The object kept constantly in view in the preparation of these Index Notes was to put, in as small a space as possible, such short descriptions of the scope and general character of the current engineering literature of a periodical or fragmentary character as would enable one in search of valuable information on a particular subject to decide whether or not it would be worth his while to obtain or consult the original article, paper, or report. No abstracts, or results, or summaries have been made, and no conclusions given. In other words these notes only serve to indicate where valuable data can be obtained. It is mostly limited also to the fields of civil and mechanical engineering. That is to say, chemical and metallurgical subjects in mining engineering have not been indexed, while other subjects in this general field more closely related to the work of civil and mechanical engineers have been taken. Articles of a casual or passing interest, but of no permanent value have not often been indexed, and such matter as was thought to lead to erroneous conclusions or as were based on false assumptions or theories, have always been excluded.

Since its inception the preparation of these notes has been under the direct control of the undersigned, nearly all the notes for the first two years having been prepared by him. Since that time the work has been performed in succession by Mr. C. V. Mersereau (C. E., Cornell) M. Am. Soc. C. E., C. W. Melcher (M. E. Washington University.) M. Am. Soc. M. E., O. E. Hovey, (C. E., Thayer) Instructor in Civ. Eng., Washington University, and F. E. Turneure (C. E., Cornell) Instructor in Civ. Eng., Washington University. Valuable assistance has also been rendered by Prof. Geo. F. Swain, M. Am. Soc. C. E. and by Mr. Clemens Herschel, M. Am. Soc., C. E. No simply clerical workers have ever been employed, and it is thought that the expression of opinion or of favor found in these notes may generally be relied on. The final preparation of this seven year summary for the press, its arrangement, classification, and the cross-references, has devolved upon Mr. Turneure, who has been assisted by Mr. T. L. Condron C. E.

The value of a carefully prepared index such as is here offered can scarcely be overestimated. Even though the publications to which the references are made are not in one's private library, they generally are accessible and can be found in public or society libraries. On the other hand even though these volumes all stand on one's own shelves, if he does not know what they contain, or where to find an article which he dimly

remembers to have seen, the task of making the search is so great as to forbid the effort, and the volumes remain unconsulted. It is the writer's firm belief that an index, such as this, without a library is of more value to a student than the library if he has no index to its contents.

If the volume now put forth should be appreciated for what it contains rather than criticised for what it lacks, and if it should contribute somewhat to the cause of good engineering in America, those to whom its usefulness is due will feel fully repaid for what has been largely a labor of love.

J. B. JOHNSON,

*Manager Index Department.*

WASHINGTON UNIVERSITY, St. Louis, Apr. 15, 1892.





## LIST OF PERIODICALS, ETC., INDEXED.

### WITH GENERAL ABBREVIATIONS.

- 
- Age of Steel (*Age of Steel*), weekly, Equitable Building, St. Louis, Mo.
- American Architect (*Am. Arch.*), weekly, Ticknor & Co., 211 Tremont Street, Boston, Mass.
- American Engineer. (*Am. Eng.*)
- American Journal of Railway Appliances (*Am. Jour. Ry. Appli.*), monthly, World Building, New York.
- American Machinist (*Am. Mach.*), weekly, 96 Fulton street, New York.
- American Manufacturer and Iron World (*Am. Mfr.*), weekly, Pittsburg, Pa.
- Annales des Ponts et Chaussees (*Annales des P. & C.*), monthly, Vve. Ch. Dunod, 49 Quai des Augustins, Paris, France.
- Annales des Travaux Publics, Paris, France.
- Building, (*Building*), weekly, New York City.
- Cassier's Magazine (*Cassier's Mag.*), New York City.
- Centralblatt der Bauverwaltung.
- Der Civil Ingenieur.
- Deutsche Bauzeitung (*Deutsche Bauzeitung*.)
- Electrical Review (*Elec. Rev.*), weekly, 22 Paternoster Row. London, England.
- Engineering (Lon. *Eng.*), weekly, London, England.
- Engineering and Mining Journal (*E. & M. Jour.*), weekly, 27 Park Place, New York.
- Engineering News (*Eng. News*), weekly, Tribune Building, New York.

## VIII

Engineering Record (*Eng. Rec.*), weekly, formerly The Sanitary Engineer, (*San. Eng.*), and the Engineering and Building Record (*Eng. & Build. Rec.*), 227 Pearl street, New York.

Fire and Water, (*Fire & Water*), New York City.

Illinois Society of Engineers and Surveyors, (*Rep. Ill. Soc. Eng. & Surv.*), Champaign, Ill.

Indian Engineering (*Ind. Eng.*), weekly, Calcutta, India.

Iron, (*Iron*), weekly, London, England.

Journal of the Association of Engineering Societies (*Jour. Assn. Eng. Soc.*), monthly, 51 Lakeside Building, Chicago.

Journal, Engineering Society, Lehigh University, (*Jour. Eng. Soc. Lehigh University*), Bethlehem, Pa.

Journal of the Franklin Institute (*Jour. Frank. Inst.*), monthly, Franklin Institute, Philadelphia, Pa.

Journal fur Gasbeleuchtung und Wasserversorgung, (*Jour. f. Gasbel. u. Wasserversorgung.*)

Journal of the New England Water Works Association (*Jour. N. E. W. W. Assn.*), quarterly, 113 Devonshire St., Boston, Mass.

Journal Royal Society of New South Wales (*Australia.*)

Journal of the Society of Arts (*Jour. Soc. Arts*), weekly, London, England.

Locomotive Engineering, (*Loc. Eng.*), monthly, 9-12 Temple Court, New York.

Manufacturer and Builder (*Mfr. & Build.*), monthly, New York City.

Mechanics (*Mechanics*), monthly, 907 Arch Street, Philadelphia, Pa.

Mining and Scientific Press. (*Min. & Sci. Press*), weekly, San Francisco, Cal.

Nouvelles de la Construction.

Popular Science Monthly, (*Pop. Sci. Monthly*), New York City.

Power (*Power*), monthly, 113 Liberty Street, New York.

Proceedings American Institute of Mining Engineers (*Proc. A. I. M. E.*), 13 Burling Slip, New York.

Proceedings, Cleveland Institute of Engineers, (*Proc. Cleveland Inst. Engrs.*), England.

Proceedings of the Engineers' Club of Philadelphia (*Proc. Eng. Club, Phila.*), quarterly, 1122 Girard St., Philadelphia, Pa.

Proceedings Indiana Association, Surveyors and Engineers, (*Proc. Ind. Assn. Surv. & Eng.*), Rensselaer, Ind.

Proceedings of the Institution of Civil Engineers (*Proc. Inst. C. E.*), 25 Great George St., Westminster, S. W., London, Eng.

- Proceedings Master Car Builders' Association, (*Proc. M. C. B. Assn.*)
- Proceedings Michigan Engineering Society (*Proc. Mich. Eng. Soc.*), Climax, Mich. Formerly Michigan Association of Surveyors (*Mich. Assn. Surv.*)
- Proceedings, Nebraska Society of Associated Engineers and Surveyors, (*Proc. Neb. Assn. Eng. & Surr.*)
- Proceedings of the Society of Arts (*Proc. Soc. Arts*), Mass. Institute of Technology, Boston, Mass.
- Proceedings of Society of Civil Engineers, Paris, (*Proc. Soc. Civ. Eng., Paris*), Paris, France.
- Proceedings of the United States Naval Institute (*Proc. U. S. N. I.*), quarterly, United States Naval Institute, Annapolis, Md.
- Railroad and Engineering Journal (*R. R. & Eng. Jour.*), monthly, 45 Broadway, New York.
- Railroad Gazette (*R. R. Gaz.*), weekly, 73 Broadway, New York.
- Railway Review (*Ry. Rev.*), weekly, The Rookery, Chicago Ill.
- Railway World, (*Ry. World.*), Philadelphia, Pa.
- Reports of Chief of Engineers, U. S. A., Washington, D. C.
- Reports of Ohio Society of Engineers, Columbus, Ohio.
- Revue des Mines.
- Sanitary News. (*San. News.*)
- School of Mines Quarterly (*Sch. Mines. Quart.*), Columbia College, New York.
- Science, (*Science*), monthly, New York City.
- Scientific American (*Sci. Am.*), weekly, 361 Broadway, N. Y.
- Scientific American Supplement (*Sci. Am. Sup.*), weekly 361 Broadway, New York.
- Selected Papers, Rensselaer Society of Engineers, Troy, N. Y.
- Stevens Indicator (*Stevens Indicator*), Stevens Institute of Technology, Hoboken, N. J.
- Street Railway Journal (*St. Ry. Jour.*), monthly, World's Building, New York.
- Street Railway Review (*St. Ry. Rev.*), monthly, 334 Dearborn st., Chicago, Ill.
- Technology Quarterly (*Tech. Quart.*), Mass. Inst. Technology, Boston, Mass.
- The Electrical Engineer (*Elec. Engr.*), monthly, 11 Wall Street, New York.
- The Electrical World (*Elec. World*), weekly, 177 Times Building, New York.

- The Electrician and Electrical Engineer, (*Electrician & Elec. Eng.*)
- The Engineer (Lon. *Engineer*), weekly, London, England.
- The Engineering Magazine (*Eng. Mag.*), monthly, World Building, New York.
- The Iron Age (*Iron Age*), weekly, New York City.
- The Locomotive (*Locomotive*), monthly, Hartford, Conn.
- The Mechanical World (*Mech. World*), weekly, Manchester, England.
- The National Car and Locomotive Builder, (*Nat. Car & Loco. Build.*), monthly, New York City.
- The Polytechnic, (*Polytechnic*), Troy, N. Y.
- The Practical Engineer, (*Practical Engineer.*), London, England.
- The Progressive Age (*Progressive Age*), Philadelphia, Pa.
- The Railway Engineer (*Ry. Eng.*), monthly, 8 Catherine St., Strand, W. C., London, Eng.
- The Railway Master Mechanic (*Mast. Mech.*), monthly, "The Rookery," Chicago Ill.
- The Sanitarian, (*Sanitarian*), New York City.
- The Technograph, (*University of Illinois Annual*), Champaign, Ill.
- The Street Railway Gazette (*St. Ry. Gaz.*), monthly, 8 Lakeside Building, Chicago.
- The Technic (*Technic*), University of Michigan, Ann Arbor, Mich.
- The Transit (*Transit*), University of Iowa.
- Transactions of the American Institute of Electrical Engineers, (*Trans. A. I. E. E.*), Temple Court, New York City.
- Transactions American Society of Civil Engineers (*Trans. A. S. C. E.*), 127 East Twenty-third street, New York.
- Transactions American Society of Mechanical Engineers (*Trans. A. S. M. E.*), 12 West 31st Street, New York.
- Transactions Arkansas Society of Civil Engineers Architects and Surveyors, (*Trans. Ark. Soc. C. E., Arch. & Surv.*), Little Rock, Ark.
- Transactions Canadian Society of Civil Engineers (*Tran. Can. Soc. C. E.*), Sec'y McGill University, Montreal, Canada.
- Transactions Engineers Society of Western Pennsylvania, (*Trans. Eng. Soc. W. Penn.*) Pittsburgh, Pa.
- Transactions Liverpool Engineering Society, (*Trans. Liverpool Eng. Soc.*), Liverpool, England.
- Transactions of the Technical Society of the Pacific Coast (*Trans. Tech. Soc. Pac. C.*), Rooms 14-15, 408 California street, San Francisco, Cal.
- Van Nostrand's Engineering Magazine (*Van Nos. Eng. Mag.*), New York City.
- Van Nostrand's Science Series, (*Van Nos. Science Series.*), New York City.

Wochenschrift des Oesterreichischen Ingenieur und Architekten Vereins,  
(*weekly*), Vienna, Austria.

Zeitschrift des Architekten und Ingenieurs Vereins (*Zeitsch. des Arch.  
u. Ing. V.*) Hanover, Germany.

Zeitschrift fur Bauwesen, (*Zeitsch. Bauwesen.*)

Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereins,  
(*Zeitsch. des. Oesterr. u Arch. V.*), Vienna, Austria.

Zeitschrift des Vereins Deutscher Ingenieur.

Zeitschrift fur Vermessungswesen, (*Zeitsch f. Vermessungswesen.*)

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There are a number of other references which are not catalogued above, for the reason that they are self explanatory and not of such frequent occurrence.





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## DESCRIPTIVE INDEX.

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**Abrasive Processes in the Mechanic Arts.** A paper by John Richards read before the Tech. Soc. Pac. C., describing various cutting and grinding processes, and machines employed. *Ry. Rev.*, Sept. 12, 1891, pp. 603-4, *et seq.*

**Accidents in Mines.** A paper by Sir Fred. A. Abel, giving general review of legislation on, in England, and of causes and remedies which now obtain. *Proc. Inst. C. E.*, Vol. XC., p. 160.

See *Railroad Accidents, Mines, Bridge Accidents.*

### Addresses.

**Baker, I. O., President Illinois Society Engineers and Surveyors.** Points out desirable changes in engineering practice of building roads, bridges, etc. *Rep. Ill. Soc. Engrs. & Surveyors*, 1888, pp. 14-27.

**Babcock, G. H.** President's address before the American Society of Mechanical engineers, on "The Engineer, His Commission, and His Achievements." *Trans. A. S. M. E.*, Vol. IX., (1888), pp. 23-37.

**Bayles, J. C.** President's address before the Inst. of Min. Engrs. at Pittsburgh, Feb. 1886. By J. C. Bayles. A forcible presentation of many of the temptations and moral pitfalls in the way of engineers, arising from their professional practice, and of the honorable course to pursue. Valuable for young engineers. *Sci. Am. Sup.*, Feb. 27, 1886.

**Becker, M. J.** *Annual Address of Pres. Am. Soc. C. E.* Delivered at Seabright, N. J., p. 20. *Trans. A. S. C. E.*, June, 1889, Vol. XX., p. 233.

**Brace, G. B., to the Institution of Civil Engineers.** Gives his address on assuming the President's chair. A general review of engineering. *Engineer*, Nov. 11, 1887.

**Chanute, Octave, Pres. Am. Soc. C. E., at the Annual Convention at Chattanooga, Tenn., May 22, 1891.** Reviews some of the leading engineering works of the past year, and discusses new engineering proposals. *Trans. A. S. C. E.*, Vol. XXIV, May, 1891, pp. 397-429.

**Chanute, Octave, President of the A. S. C. E., at the American Patent Celebration,** on "The Effect of Invention Upon the Railway and Other Means of Intercommunication." A review of the progress in transportation, economic importance of the railway and probable future improvements. Condensed and printed in *Eng. News*, May 2, 1891, pp. 419-20.

**Cleeman, T. M., Annual Address to the Engineers' Club of Philadelphia.** By T. M. Cleemann, retiring President. Gives a comparison of the growth of engineering societies and a brief review of the work Philadelphia and Pennsylvania have accomplished. *Proc. Eng. Club, Philadelphia*, Vol. VI., pp. 225-234, (Feb., 1888).

## Addresses, continued.

- Cooley, L. E.*, Retiring Address of President L. E. Cooley to the Western Society of Engineers, on "The Modern Spirit of the Engineering Profession." *Four. Assn. Eng. Soc.*, Feb., 1891, pp. 63-8.
- Corthell, E. L.*, on Retiring from Presidency of the Western Society of Engineers. *Four. Assn. Eng. Soc.*, May, 1890, pp. 209-233.
- FitzGerald, Desmond*, President Boston Soc. of C. E. Delivered March 20, 1889. *Four. Assn. Eng. Soc.*, May, 1889, Vol. VIII., p. 251.
- Flad, Henry*. One Year of Engineering Progress. The annual address before the Denver meeting of the American Society of Civil Engineers. *Eng. News*, July 17, 1886.
- Herschel, Clemens*, Pres. Boston Soc. C. E., "On the Advancement of the Profession of the Civil Engineer." *Eng. News*, Apr. 11, 1891, pp. 355-6, *et seq.*
- Jones, Washington*. A review of the great projects of the year. By the retiring President of the Philadelphia Engineers' Club. *Proc. Eng. Club Phila.*, Vol. VI., p. 81.
- Meier, E. D.*, on Retiring from the Presidency of the St. Louis Engineers' Club. *Four. Assn. Eng. Soc.*, Feb., 1890, Vol. IX., pp. 43-50.
- Potter, W. B.*, Retiring President, Engineers' Club of St. Louis. Gives brief history of the club and discusses its work and relations with other societies. *Four. Assn. Eng. Soc.*, Jan., 1888, pp. 22-28.
- Preece, W. H.*, Pres., to the Mechanical Science Section of the British Association, Bath, 1888. Reviews the developments of the practical applications of electricity. *Engineer*, Sept. 7, 1888; *T. J. and Elec. Rev.*, Sept. 7, 1888; *Four. Soc. Arts.*, Sept. 14, 1888; *Sci. Am. Sup.*, Sept. 29, 1888.
- Searles, William H.*, President Civil Engineers' Club of Cleveland. "The Outlook for Local and General Engineering Societies." *Four. Assn. Eng. Soc.*, Apr. 1891, pp. 194-7.
- Shinn, Wm. P.*, President A. S. C. E., at Cresson meeting. *Eng. News*, July 5, 1890, pp. 9-11.
- Warner, W. R.*, President C. E. Club of Cleveland, at the annual banquet, March 29, 1890. *Four. Assn. Eng. Soc.*, July, 1890, pp. 353-6.
- Worthen, Wm. E.*, Before Am. Soc. C. E. Gives resume of the work of engineers during the past year. *Eng. News*, July 9, 1887; *San. Eng.*, July 16, 1877.
- Wright, A. W.*, to the Western Society of Engineers. Gives brief review of some of the principal engineering achievements of the year. *Four. Assn. Eng. Soc.*, Vol. VI., p. 181.
- Adjutages, Submerged, Experiments with.* By C. W. Clark. Gives details and results of experiments made at the University of Illinois. *Four. Assn. Eng. Soc.*, Vol. VI., p. 308.

## Aerial Navigation.

- Extended discussion of the subject by Wm. Pole, F. R. S., in a paper before the *Inst. of Civ. Engrs.*, Vol. LXVII. Also, by same author, "Some Further Data on Aerial Navigation." *Am. Engr.*, Aug. 6, 1885. The former article is one of the most valuable that has ever appeared.
- Flying Machine Memoranda.* By L. Hargrave. Figure of 8 wing movement, and engine. Screw driver flying machine. Three cylinder air engine, and flying model. Theory of air rollers. *Royal Society of New South Wales: Journal.* Vol. XXIII., pp. 70-74. 8 plates.
- Gen. Thayer's System of Dirigible Balloons, either moving on wire "balloon-ways," or wholly disconnected from the earth. Fully illustrated in *Sci. Am.*, Dec. 26, 1885.
- Improvements in.* By Prof. W. Le Conte Stevens. An historical article, giving the recent improvements made in France up to 1885. Illustrated. *Pop. Sci. Monthly*, July, 1885.

**Aerial Navigation, continued.**

Interesting illustrated lecture delivered by Mr. O. Chanute, C. E., at Cornell Univ. *R. R. & Eng. Jour.*, July, 1890, *et seq.*, pp. 316-8.

*Mechanical Flight.* A practical criticism of Prof. Langley's article in the *Century Magazine*, by Wm. H. Harrison. *Am. Mach.*, Oct. 1, 1891.

*Mechanics of Flying.* By Ludwig Kargl. Object is to investigate under what circumstances it is possible for a machine to raise itself into the atmosphere and at the same time guide its motion in any given direction. *Van. Nos. Eng. Mag.*, Vol. IV., pp. 346-530.

*Military Ballooning in France.* An account of the most recent results attained. Illustrated. *Sci. Am. Sup.*, Nov. 6, 1886.

*Power Required.* By Hiram S. Maxim. Explains the principle of the aeroplane and describes his apparatus for testing it, giving general results of tests. *Century Mag.*, Oct., 1891, pp. 829-36.

*Present State of,* giving most modern devices, with mathematical discussion of principles, by M. DeBruignac. *Proceedings of Society of Civil Engineers*, Paris, October, 1884.

*Problem of Air Navigation.* A popular article by Prof. R. H. Thurston, discussing the history of the problem and experiments and observations upon birds. *The Forum*, Vol. VIII., pp. 542-54.

*Progress in.* A review by O. Chanute. *Illus. Eng. Mag.*, Oct. 1891, pp. 1-13.

*Progress in, (continued).* Article by Mr. O. Chanute containing illustrations of various flying machines from 1500 to 1879. *R. R. & Eng. Jour.*, Nov. 1891.

*Prospects of Successful.* Extract from letter in *New York Times*, by Hiram S. Maxim, stating how he is at present working on this problem. *R. R. & Eng. Jour.*, January, 1891.

Short sketch of its history and a description of a new form of motor for an air ship. *Am. Eng.*, May 22, 1885.

*Vacuum vs. Inflation.* A paper by Dr. A. de Bausset, Boston, Mass. *Am. Engr.*, Nov. 29, 1890, pp. 238-9, *et seq.*

**Aerodynamics, Experiments in.** By Prof. S. P. Langley, being experimental demonstrations of certain propositions in aerodynamics which prove that "flying" under proper direction is practicable. Very extensive experiments with "planes." Detailed description, results, etc. No. 801. Vol. XXVII., *Smithsonian Series*, 1891. pp. 115, pls. X.

**Air.**

*Flow of, through Orifices in a Thin Plate.* By A. Fliegner. Gives formula derived from experiments made with orifices from 3.17 to 11.36 millimeters in diameter. *Van. Nos. Eng. Mag.*, Vol. XXV., p. 217.

*Flowing in Pipes, Coefficient of Friction of.* By Prof. W. C. Unwin, M. I. C. E.

*In Large Towns.* A paper by William Thomson on the injurious effect of the air in large towns on animal and vegetable life, and the methods of securing a salubrious air. *Van. Nos., Eng. Mag.*, Vol. XX., p. 488.

*Test of its Purity as to Carbonic Acid.* A simple and exact quantitative test that may be applied by any one to test the fitness of air for breathing. *Abs. Proc. Inst. C. E.*, Vol. LXXXI., p. 384.

**Air Resistance. An Experimental Study of.** A valuable paper read by Mr. O. T. Crosby before the West Point branch of the Military Institute. Whirling experiments with velocities between 12 and 130 miles per hour seemed to show clearly a recti-linear relationship between pressure and velocity. Results plotted. Mr Crosby deduces the novel equation  $P = 14.1 V^2$ ,  $P$  being in pounds per sq. ft. and  $V$  in miles per hour. *Lon. Eng.*, May 31, June 6 and 13, 1890. *Eng. News*, May 31, June 7, 14, 21, 1890, pp. 505, 530, 561, 589. Abstract in *Ry. Rev.*, June 7, 1890, pp. 326-8. Abstract and comments, *Lon. Engineer*, June 6, 1890, p. 461.

**Air resistance, continued.**

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*Deflection*. See *Bridge Stress and Deflection*.

*Designing of*. See *Bridge Designing*.

*Detroit River, Proposed*. Plan and elevation of the proposed Winter bridge across the Detroit River, at Detroit. *Eng. News*, March 5, 1887.

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*Draw*. See *Bridges. Draw* below.

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*Duluth. Project for a Combined Railway and Highway Steel Bridge over the ship canal, Duluth, Minn.* By Alfred P. Boller, C. E. *An. Report of the Board of Public Works, Duluth, for the year ending Feb. 28, 1890*, pp. 97-104.

*Economy in*. See *Bridges, Long Span*.

*Over the Elbe at Hamburg and at Harburg*. Built 1869-72. Spans of about 325 feet of "fish-belly" form, built of wrought iron; the upper chord consists in itself of two chords and panel bracing, as does likewise the lower chord, and the



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two are connected by vertical suspension rods only, these suspension rods holding up the track construction. The constructive analysis of the bridge makes it an arched bridge, with parallel chords and panel bracing, supported on towers erected on the piers, the height of the towers equal to the deflection of the stiffened suspension bridge structure (above spoken of as the lower chord of the "fish-belly" bridge), and whose sole office is to neutralize the thrust of the arch. The bridge platform, or track construction, is tangent to this double lower chord, and is supported from the arch by suspension members. A comparison of the weight of this bridge with others of like span and strain on the materials of construction, shows it to be a favorable form of bridge-truss, as far as own weights are concerned. *Zeitschrift f. Bauwesen.* 1885, pp. 75-178.

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*Floors of.* See *Bridge Floors*.

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*Forth.* See *Bridges, Cantilever*.

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*Guard Gates.* Description of Guard gates at Point street bridge at Providence, R. I. Paper by Wm. D. Bullock, M. Am. Soc. C. E., giving description and complete illustrations of gates and operating machinery. *Trans. A. S. C. E.*, Feb., 1889, Vol. XX., p. 78.

*Guard Rails on.* See *Bridge Guards*

*Hannibal.* Gives description of the combined highway and railroad bridge across the Mississippi River at Hannibal, Mo. *Van Nos. Eng. Mag.*, Vol. V., p. 306.

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A two-page plate showing general design and details. *Lon. Eng.*, Feb. 25, 1887.

A description of the above bridge, with plates showing strain sheet, method of loading and various details. *Lon. Eng.*, April 8-22, 1887.

*Hawkesbury, New South Wales.* Illustrations and description of the method of erecting on pontoons and floating to place. *R. R. Gas.*, Aug. 10, 1888; *Indian Engineer*, July 28, 1888; *Sci. Am. Sup.*, Aug. 11, 1888; *Lon. Eng.*, Sept. 7, 1888.

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**Bridges, continued.**

*Highway.* See *Bridges, Highway*, below.

*History of.* See *Bridge History*.

*Howe Trusses.*

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See *Bridge Designing, Arching, etc. Howe Truss*.

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*Pile and Trestle.* See *Bridge Members. Bridges, Trestle.*

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*Pony Lattice, W. S. R. R.* Gives plan, elevation and cross-section, with dimensions of a pony lattice bridge truss built at Normanskill, N. Y., on the West Shore Railroad. Span, 86 ft.; clear width, 14 ft.; height, 10 ft., and weight, 50 tons. *R. R. Gaz.*, Sept. 21, 1888.

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**Sioux City Bridge.** Description condensed from a report by George S. Morison, Chief Eng. Illustrated. *R. R. & Eng. Jour.*, May, 1891, pp. 219-22.

**Skew.**

**Boylston Street Bridge, Boston, Mass.** Illustrated description of the interesting skew bridge, with photo engravings showing process of erection. *Rep. City Engineer of Boston, Mass.*, 1888, p. 19.

**Central Avenue, at Newark, N. J.** By A. P. Boller. Describes a novelty in bridge engineering. The bridge crosses the Morris Canal at a very sharp angle, and is also intersected by two streets. *Trans. A. S. C. E.*, Vol. II., p. 379.

**On the Illinois Central Railway.** Description and illustrations of a skew span crossing an 82-foot canal at an angle of  $22^{\circ} 20'$ , four tracks; two independent spans of two tracks each. *Ry. Rev.*, Jan. 18, 1890, p. 32.

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**Stresses in.** See *Bridge Stresses*.

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*Traveling.* A brief illustrated description of a traveling bridge or rolling ferry, between St. Malo and St. Sevan, in north France. Docks of masonry are built out from either side into the harbor leaving a waterway of 300 ft.; they are 35 ft. high, tide being 33 ft. The bottom is bare at low tide. The truck runs on two rails placed on the bottom and will carry about 100 passengers. *San. Eng.*, April 23, 1887.

*Trestle.* See *Bridges, Trestles* below.

*Van Buren, Ark.*

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*Vibration of* See *Bridge Vibration*.

*Victoria Tubular.* History and description. *Eng. News*, July 12, 1879, p. 221. From Lon. *Eng.*

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*Weights of.* See *Bridge Loads*.

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Descriptive article with a very valuable inset plate giving the strain diagram and ordering sheet as actually used for one of the 283-foot spans of the Winner Bridge, by Mr. Frank D. Moore, C. E. the Chief Engineer. *Eng. News*, March 15, 1890, Vol. XXIII., p. 249.

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## Bridges, Arches.

*Belfast. New Logan Cast Iron Bridge.* Illustrated description of this handsome arch bridge. *Lon Engineer*, Aug. 22 and 29, 1890.

*Ben Rhydding, Eng.* Gives brief description with two-page plate of detailed drawings, of two lattice arches, with suspended roadway, over the River Wharfe near Ben Rhydding, Yorkshire. *Lon. Engineer*, May 25, 1888.

*Brunswick, Eng.* Gives two-paged plate showing elevation and details of a hinged-arch foot bridge, spans 79 feet, over the River Oker at Brunswick, England. *Lon. Eng.*, Aug. 17, 1888.

*Bow Girders (three-hinged Arches) which do not change the Signs of the Moments, the Load Running over the Bow.* A theoretical investigation, by E. W. Welker. *Eng. News*, Oct. 2, 1880, p. 331.

*Cedar Avenue Bridge—Baltimore, Md.* A braced arch of 150 ft. span. General view and page of details. *R. R. Gaz.*, Sept. 18, 1891, pp. 649-51.

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*Driving Park Avenue Bridge, Rochester, N. Y.* A three-hinged iron arch of 428 ft. span. Full description with detail drawings. *Eng. Record*, July 18, 1891, *et seq.* Brief description, *R. R. Gaz.*, July 17, 1891, pp. 492-3.

*Gruenthal.* See *Canals, Ship, North Baltic.*

*Harlem River. Designs for the proposed*, at One Hundred and Eighty-first street, which were awarded the first and second prizes. *Eng. News*, also *Sci. Am.*, March 6, 1886. The accepted design, as modified from those presented. Cut given in *Eng. News*, April 10, 1886. Detailed drawings and specifications for the new Harlem River bridge; also, illustrated description of the design for the Harlem River bridge submitted by Messrs. Vaux and Radford. *Eng. News*, July 31, 1886. Designs submitted for, *Eng. News*, Dec. 27, 1890, p. 564.

Plan and elevation showing the arrangement of the plan and the condition of the work just before the last segments of span No. 2 were closed. *Eng. & Build. Rec.*, Jan. 21, 1888. False Works, skewback segment and hinges are shown in *Eng. News*, Feb. 4, 1888.

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*Javroz Bridge in Freiburg, Switzerland.* Short description, with illustrations, of this iron arch of 285 feet span, without hinges. *Deutsche Bauzeitung*, 1885, p. 546-548.

*Illinois and St. Louis.*

By Theo. Cooper. Gives notes on the mode of setting and adjusting the skew backs on the insertion of the centre tube of the different spans, and the tests of the completed bridge. *Trans. A. S. C. E.*, Vol. III. (1874), pp. 239-254.

*Reconstruction of the Floor of.* By N. W. Eayrs. Gives details, with drawings, of the plan adopted in the reconstruction of the railroad floor of the St. Louis bridge. *R. R. Gaz.*, Aug. 31, 1888.

*Minneapolis Steel Arch Bridge.* Brief and well illustrated description of main features of this structure. *Eng. & Build. Rec.*, May 10, 1890, p. 358.

*Paderno, Italy.* Gives brief description, with elevation and cross section, of a bridge to be built over the River Adda, at Paderno, Italy. Length of main arch, 492 ft.; rise, 123 ft.; lattice truss spans, 109 ft.; total length, 997 ft. *R. R. Gaz.*, Sept. 14, 1888.

**Bridges, Arches, continued.**

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*Raising a Masonry Bridge in France.* Account of the raising of an existing arch by cutting through at the springing line and lifting by screws. From *Annales des P. & C. Eng. News*, Oct. 3, 1878, pp. 315-16.

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*Stone Bridge, St. Anthony's Falls (Miss. River).* Description. Illus. *R. R. Gaz.*, Nov. 23, 1883, p. 772.

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See *Arches. Bridge Stresses.*

**Bridges, Cantilever, Forth.**

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*Erection of.* By A. S. Biggart. A paper before the British Association, treating of the problems that occurred during the erection of the Forth bridge and methods of overcoming them. Illustrated. *Lon. Engineer*, Nov. 25, 1887. *Sci. Am. Sup.*, Dec. 31, 1887.

*South Pier.* A full-page illustration showing the erection of the south pier of the Forth bridge. *Eng. News*, April 2, 1887.

*Erection of Superstructure.* By A. S. Biggart, before the Scotland Institution of Engineers and Shipbuilders. Describes briefly the principal features of the erection of the superstructure of the Forth bridge. *R. R. Gaz.*, May 18, 1888.

*Fife Cantilever Pier.* A two-page plate of the Fife cantilever pier of the Forth bridge, showing all of the main tubes and connections, including junction girders completed to the full height of 362 feet, the north cantilever carried out 170 feet, the first struts and braces to a height of 240 feet, and 130 feet of the viaduct completed. *Lon. Engineer*, Feb. 3, 1888. A small view of the same in *Lon. Eng.*, Jan. 27, 1888, also *Eng. News*, March 10, 1888.

*Floor system of the Forth Bridge.* Illustration and detail description of manner of laying rails, etc. Rails are laid in a trough. *Ry. Rev.*, March, 1890; Vol. XXX., p. 151.

*Inspection of.* The final inspection report on the Forth bridge by C. S. Hutchinson and F. A. Marindin, of the Royal Engineers. *Eng. News*, March 29, 1890, Vol. XXIII., p. 305.

*Machinery at.* By Wm. Arrol, before the Institution of Mechanical Engineers. Gives description of the machinery employed in the erection of the Forth bridge. Illustrated. *Lon. Eng.*, Sept. 9, 1887.

*Observations on.* A paper read by Dr. Charles E. Emery. Elevation and sections. Tables of temperature and diagrams showing temperature movements. *Trans. A. S. C. E.*, Vol. XXII., June, 1890, pp. 409-24.

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Popular article describing several interesting features and giving a table of existing cantilever bridges. By Thos. C. Clarke, *Eng. Mag.*, Apr., 1891, Vol. I., No. 1, pp. 65-79.

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Sixteenth quarterly report of progress made to the Board of Trade. *Am. Eng.*, May 18, 1887, also *Lon. Eng.*, April 15, 1887.

*History of First Cantilever in America.* *Eng. News*, Dec. 29, 1883, pp. 627-8.

*Jubilee, Hooghly River, India.* By Sir B. Leslie. A paper before the Institution of Civil Engineers, giving details of the construction of the Jubilee bridge carrying the East Indian railroad over the Hooghly River at Hooghly. It has a central double cantilever 360 feet long by 52 feet high, and side spans 420 feet long and 47 feet deep. *Proc. Inst. C. E.*, Vol. XCII., pp. 73-141; abstract *Lon. Eng.*, Jan. 27, 1888; *Mech. World*, Feb. 4, 1887; *Lon. Engineer*, Feb. 10, 1888; *Eng. & Build. Rec.*, Feb. 4, 1888, also Oct. 4, 25, 1890.

*Kanawha River Bridge.* Very complete details of this cantilever bridge. *Eng. & Build. Rec.*, Aug. 17, 1889, Vol. XX., p. 161, *et seq.*

*Kentucky River or Tyrone Cantilever Bridge*, on the Lexington extension of Louisville Southern Ry., built by Union Bridge Co. A general description is given with several illustrations, including details of adjusting machinery, and an inset plate giving complete strain sheets and detail drawings of structure, including method of anchoring shore arm of cantilevers. *Eng. News*, April 5, 1890. Vol. XXIII., p. 319.

*Kentucky and Indiana.* By Mace Moulton. A paper before the American Society of Civil Engineers, containing a full account of the construction, with extracts from specifications, tables showing tests of materials, etc., of the bridge over the Ohio river at Louisville. Plates show design, locations, strain sheet and details. *Trans. A. S. C. E.* Vol. XVII., September, 1887, pp. 111-168; abstract in *Lon. Eng.*, Jan. 27, 1887.

**Lachine.**

Gives description with a two-page plate, with details of the bridge across the St. Lawrence River. *Lon. Eng.*, April 13, 1888.

*The Foundations.* By G. H. Massy. And *the Superstructure*, By J. W. Schaub. Illustrated. These are the first authoritative descriptions of this important structure. 35 pp. and 2 plates, including discussion. *Trans. Can. Soc. C. E.*, Vol. I., 1887, p. 36. Abstract, *Eng. News*, Oct. 1, 8, 1887.

**List of, See Bridges, Cantilevers, Forth.**

*Long Island, Proposed.* A description of the proposed bridge between New York and Long Island, over Blackwell's Island. To consist of two cantilever bridges of 810 feet in the clear, resting on braced steel piers 110 ft. high. General elevation and some details in *Eng. News*, April 23, 1887.

*Market Street Cantilever Bridge over the Schuylkill River, Philadelphia, Pa.* A paper by Fred. J. Amweg, describing the substructure, and asphalt pavement, with table of tests of iron. *Proc. Eng. Club Phila.*, Dec. 1889, pp. 201-25.

*Market Street Bridge, Philadelphia.* A deck-cantilever highway bridge, 77 ft. wide and 528 ft. long. Plans, elevations and details. *Eng. News*, Oct. 16, 1886

*Niagara River.* By C. C. Schneider, the engineer of the bridge. A most satis



**Bridges, Cantilever, continued.**

factory article on this unique design, with numerous cuts, details, specifications, deflections, etc. *Trans. A. S. C. E.*, Vol. XIV., p. 499.

A paper by C. F. Findlay, M. A., A. M. Inst. C. E. This paper gives when taken with discussion thereon, a valuable treatment of cantilever bridges. *Trans. Can. Soc. C. E.*, Vol. III., pp. 54-110, 1889.

**Poughkeepsie.**

A series of articles on the erection of the Poughkeepsie bridge. *Eng. & Build. Rec.*, May 5, *et seq.*, 1885.

By Thomas C. Clarke. The Second Sibley College lecture describing the erection of bridge over the Hudson at Poughkeepsie. *Sci. Am. Sup.*, May 19, 1888.

For an historical sketch of the project, general dimensions, description, etc., as well as many fine illustrations of the bridge and its vicinity, see *Poughkeepsie Daily Eagle*, Souvenir Edition, 1889; also *E. & M. Jour.*, Feb. 2, 1889.

*Foundation and Substructure of the Poughkeepsie.* Gives description of the methods used for founding the pier, and some details of the difficulties met and overcome. Illustrated. *Eng. News*, Oct. 29, 1887; see also *Lon. Eng.*, Aug. 26, 1887, and *R. R. Gaz.*, July 1, 1887.

*Quebec. Proposed Cantilever over the St. Lawrence.* Illustrated. *Am. Eng.*, May 1, 1885.

**Red Rock, Col.**

A description of the foundations and superstructure of the largest cantilever bridge in the U. S. A valuable folding inset shows the details. *Eng. News*, Sept. 27 and Oct. 4, 1890, pp. 274, 303-5.

An account of this bridge now under construction across the Colorado River, including outline profile, details of caissons and inset sheet of photo-reproduction. *R. R. Gaz.*, April 25, 1890, Vol. XXII., p. 278.

*St. John's River, New Brunswick.* Central Span 447 feet. Full description and cuts showing stages in erection. *R. R. Gaz.*, Oct. 30, 1885. Also *Lon. Eng.*, Aug. 6, 1886, *et seq.*

**Sukkur, India.**

Span, 820 feet. Several new features. Cut given. From *Mech. World*, London: in *Ry. Rev.*, Dec. 12, 1885; also *Lon. Engineer*, July 9, 1886.

Brief description with three full-page illustrations. *Lon. Eng.*, Jan. 4, 1889.

Illustrated article showing the various proposed crossings of the Indus, and a general view of the bridge. *Ind. Eng.*, April 22, 1889.

By Wm. Parsey. Gives a description of staging and temporary erection of the Sukkur cantilever bridge at the bridge works. A two-page plate gives details of staging, etc. *Lon. Eng.*, March 2, 1888.

A brief description, with large colored plate, of the staging for the main pillars and guys of the 820-foot cantilever span. *Ind. Eng.*, Nov. 5, 1887.

A paper by F. E. Robertson, before the Inst. C. E., describing the erection. Abstract with elevation and plan of superstructure; *Ry. Rev.*, Apr. 11, 1891, pp. 230-1.

*Theory of Cantilever Bridges. Notes on.* A paper by Charles McMillan, C. E., Professor of Civil Engineering at Princeton College. Methods of computing stresses, both analytically and graphically, are given. Illustrated by two plates. *Selected Papers of Rensselaer Soc. of Engrs.*, Vol. II., No. 2, p. 61, June, 1889.

See *Bridges, Long Span.*

**Bridges, Draw.**

*Arthur Kill.* Gives a brief description, with plan and details of the drawbridge recently constructed between Staten Island and New Jersey. Total length of draw, 496½ feet; clear water-way 206+204 feet. *R. R. Gaz.*, June 22, 1888.

**Bridges, Draw, continued.**

By Clemens Herschel. Treats on the principles of construction of and the calculation of the strains in revolving drawbridges having two spans as openings and built as continuous girders, more especially as continuous panel girders. *Trans. A. S. C. E.*, Vol. III., (1874), pp. 395-448.

*Carrying a Cable R. R. Across.* See *Cable Railroads*.

*Clarence Bridge at Cardiff.* A steel structure 464 ft. long with a 190 ft. draw span. Details of superstructure, caissons, and fenders are given with a general description of the bridge. *Lon. Eng.*, Feb. 13, 1891, pp. 185-8, *et seq.*

**Coteau.**

*The Swing Span and Pivot Pier of the Coteau Bridge; Method of Floating Spans into Place.* Illustrated description with inset showing details of machinery for operating. *Eng. News*, May 30, 1891, pp. 524-5.

An illustrated description of the process used in sinking the foundations of this Canadian bridge over the St. Lawrence. Open caissons filled with concrete were used. *Eng. News*, April 12, 1890, Vol. XXIII., p. 338.

*Electric Motor for Drawbridges.* Illustrated description of the new electric turning gear of a drawbridge at Bridgeport, Conn. *St. Ry. Jour.*, May, 1889, Vol. V., p. 119.

*Erection of a, without false works.* By C. S. Maurice. Describes the erection of a pivot-span 260 feet long over the Tombigbee River, near Demopolis, Ala. *Trans. A. S. C. E.*, Vol. II., p. 330.

*Florence Draw Bridge.* 412 ft. span with both railroad and wagon roadways. Has special hand turning gear. Details of bridge and turning gear illustrated. *Eng. Rec.*, Feb. 28, 1891, pp. 208-12.

*Folding-Floor Drawbridge.* A novel type of drawbridge recently completed at Chicago, Ill. Brief description with illustrations. *Eng. News*, May 23, 1891, pp. 486-7.

*Glamorganshire Canal Bridge.* Fully illustrated description of a highway swing bridge. Entire weight rests on the pivot. Designed by Max am Ende. *Lon. Engineer*, Aug 7, 1891, pp. 105-7.

*Hackensack Draw.* Gives description of new draw-bridge recently built by the Erie Railroad over the Hackensack River, with drawings showing details of girders, turn-table, wedges and foundations of draw span. *R. R. Gaz.*, July 20, 1888.

*Harlem River.* A brief description of the draw-bridge over the Harlem River, with illustrations of details. *Lon. Eng.*, April 1, 1887.

*Harlem River, New York.* Designed by Theo. Cooper. Operated by hydraulic pressure. Illustrated and described in *Sci. Am.*, Jan. 2, 1886.

*Hydraulic Swing.* By W. E. Armstrong. Describes the Armstrong Swing Bridge over the Ouse. *Van Nos. Eng. Mag.*, Vol. I., p. 983.

*Lifting, Tarante, Italy.* Description of a bridge at Tarante, Italy, with plates showing details. It consists of two half arcs meeting in the center when closed; each half has a rising and rotating movement, and is worked by hand or turbines. Distance between axes of rotation, 220 feet. *Lon. Eng.*, Oct. 28, 1887, *et seq.* Brief description, illustrated. *Sci. Am. Sup.*, Jan. 14, 1888.

*Lifting, Utica, N. Y.* By Squire Whipple. Gives description, with elevation and cross-section, of a "lift-draw-bridge" over the Erie Canal at Utica, N. Y. *Trans. A. S. C. E.*, Vol. III., pp. 190-4.

*Masnedsund.* Description of the swing bridge over the Masnedsund, between the Isle of Falster and Seeland, Denmark, with plan, elevation and some of the more important details. *Lon. Engineer*, March 4, 1887.

*Milwaukee.* Description of a 203-foot span double-track draw-bridge at Milwaukee. Cut showing details. *San. Engr.*, Nov. 26, 1887.

*Milwaukee.* Specifications for Draw-Bridge over Canal, for the C. M. & St. P.

**Bridges, Draw, continued.**

*Ry.* General specification for superstructure. *Eng. News*, Jan. 18, 1879, pp. 21-3.

*Newark Bay Draw-bridge.* Gives illustrated description of the old draw-bridge on the New Jersey Central road now being replaced by a new bridge. Also shows the construction of the temporary drawbridge now in use. *R. R. Gas.*, June 17, 1887.

*Pamunkey.* The erection of the Pamunkey River Drawbridge, a 150 ft. span is described and fully illustrated in *Eng. Rec.*, Feb. 14, 1891, pp. 176-7.

*Petaluma Draw.* Gives brief description, with general view and plan and elevation of the central pier of the Petaluma drawbridge on the San Francisco & North Pacific Railroad. *Eng. News*, Oct. 13, 1888.

Rolling bridge over the ——— lock in the harbor of Antwerp. *Wochenschrift des Oest. Ing.-u. Arch.-V.*, 1886, pp. 37-9.

*Swinging Drawbridges by Electricity.* Brief article describing arrangement of motor and gearing of a Chicago drawbridge. *R. R. Gas.*, Aug. 21, 1891, p. 578.

*St. Mary's Falls Canal Bridge and Dam.* An illustrated description of this draw span, with attached movable dam. Includes illustrations of principal details and complete strain sheet. *Eng. & Build. Rec.*, March 22, 1890, Vol. XXI., p. 246.

*Thames River Bridge.* Complete general description. Abstract from the report of Alfred P. Boller, Chief Eng., *Eng. & Build. Rec.*, Oct. 11, 1890, pp. 295-7. Details of floor beams, pedestals and piers, *ibid*, Oct. 18, 1890, pp. 310-11. Drawings of turn-table, rail-lifts and locks, *Ry. Rev.*, Oct. 25, 1890, pp. 634-5. Piers and superstructure, *id.*, Nov. 29, 1890, pp. 713-15. Foundations, *R. R. Gas.*, Nov. 7, 1890, pp. 763-4.

*Tower Bridge.* London. A series of illustrations of various details of this new and interesting structure, foundations and superstructure. *Lon. Engineer*, Vol. LXVIII., pp. 138, 140, 179, 202, 329, 336, 386, etc., 1889.

*Tower Bridge at London.* Short general description with illustration. A novelty in draw bridges. *R. R. & Eng. Jour.*, Oct., 1890.

*Wells Street, Chicago, Removal of.* Gives details of the moving of the Wells street draw-bridge, bodily, to its new position on Dearborn street. *Eng. & Build. Rec.*, April 14, 1888.

*And their Turn-Tables.* By C. Shaler Smith. A paper for "non-specialists," showing method of computing the strains; also, gives table of draw-bridge tests to obtain co-efficient of rolling friction. *Trans. A. S. C. E.*, Vol. III., pp. 129-41.

*Willamette River.* *Bridges of the Oregon Railway & Navigation Co.*, over the Willamette River at Portland, Oregon, with illustrations of "Draw" in detail. *R. R. Gas.*, April 19, 1889.

*Winona Bridge.* Brief description of the entire structure, with details of trusses, turning and lifting machinery of the swing span, illustrated. Specifications as to quality of steel also given. *Eng. News*, Oct. 17, 1891, p. 370.

See *Bridges, Arches, Tower.*

**Bridges, Girders.**

*Bengal-Nagpur Railway Bridges.* Specification for triangulated girder bridges, with insert, giving complete details. *Ind. Eng.*, May 18, 1889.

**Continuous.**

*Application of the Theory of, to Economy in Bridge Building.* By Chas. Bender. Reviews at length the many objections to the use of continuous girders, derives working formula, and compares weights with those of equal discontinuous spans. Illustrated. *Trans. A. S. C. E.*, Vol. V. (1876), pp. 147-198.

## Bridges, Girders, continued.

*Calculation of Continuous Girders*, analytically and graphically. By M. Bertrand de Fontviolant. A lengthy paper, containing a tolerably full discussion of the subject, including, besides the well-known theories, some investigations regarding effect of deformation of piers, and temperature. The paper, however, contains little, especially in the graphical treatment, which has not been given in previous discussions of the subject. *Memoires de la Soc. des Ing. Civ.*, Sept., 1885, pp 255-348, with 2 plates.

Discussion of continuous girders, with examples, by Mr. M. S. Hodgins. *Van Nos. Eng. Mag.*, Vol. XIX., p. 553.

*International across the River Minho* (Spain and Portugal). Detailed description of foundations and superstructure, lattice continuous girder, 5 spans, 61.5 to 69 meters, progress of the work, tests of materials, etc. *Revista de Obras Publicas*, 1886, January to June.

Paper by Chas. Bender on the application of the theory of continuous girders to economy in bridge building, with discussion. *Trans. A. S. C. E.*, Vol. V., p. 146.

Stress produced in continuous girders during launching. Said to be the first published solution of the problem. Illustrated. *Lon. Eng.*, Nov. 27, 1885.

*Theory and Construction of*. By Mansfield Merriman. The object of the paper is to present some of the main principles and laws and to illustrate this application to the practical designing of continuous bridge. *Van Nos. Eng. Mag.*, Vol. XV, pp. 145 and 193. Also *Van Nos. Sci. Series*, Vol. XXV. A criticism on the above by Chas. Bender. *Van Nos. Eng. Mag.*, Vol. XV., p. 289.

Variable Moment of Inertia. Moment and Load Coefficient. Graphical method. Illus. By C. H. Lindenberger. *Four. Frank. Inst.*, Jan., 1891.

*Chenab, India*. Gives two pages of detailed drawings and abstracts from the specifications of the Chenab bridge, India state railroads. It is composed of 17 spans, of 206 feet each, of riveted triangular girder, *Lon. Engineer*, Sept. 14, 1888.

*Dalmarnock Bridge*. Fully illustrated description of this plate girder bridge at Glasgow. Details of piers are given. *Lon. Eng.*, March 28, 1890, p. 385.

*Flanges. The Lateral Stability of*. Theoretical discussion including the relation of wave length to stability. By Max am Ende. *Lon. Engineer*, May 29, 1891, pp. 419-20.

*Formulas for the Weight of Girder*. By Max am Ende. A discussion of the various formulas. *Proc. Inst. C. E.*, Vol. LXXXVII., p. 386.

*Lattice Girder Overhead Crossing*, Chicago, Santa Fe & California Ry. Paper by W. H. Breithaupt, read before the Engineers' Club of Kansas City, June 18, 1888. *Four. Assn. Eng. Soc.*, Jan., 1889.

*Napier Bridge Madras*. An old lattice girder of ten 50 ft. spans on screw piles. Illustrated description. *Ind. Eng.*, May 2, 1891, p. 352.

*On some Points for the Consideration of English Engineers*, with reference to the Design of Girder Bridges. A paper before the Br. Assoc. Adv. Sc. Opposes the Board of Trade Rules and favors the American practice. *Lon. Engineer*, Sept. 10, 1886. Also *Eng. News*, Oct. 30, 1886.

## Plate.

*Highway Bridge; Brookline, Mass.* Sections of abutments and wing-walls, with inset of details of girders. Owing to lack of head room the water pipe is carried through the triangular openings in the floor beams. *Eng. News*, Sept. 19, 1891, pp. 257-8.

Paper with formulas, plates and practical suggestions, by M. J. Becker, Chief Engr., P., C. & St. L. Ry. *Report Ohio Soc. Surv.*, 1885.

*Web. Thickness of*. By J. J. Webster. A sensible discussion of the subject. *Trans. Liverpool Eng. Soc.*, Vol. III., p. 49.

**Bridges, Girders, Plate, continued.**

*Pin Bearing Plate Girder Railroad Bridge.* A 3-span girder, lower flange continuous, pin bearings. one end of the bridge being fixed and the other bearings on rockers. Illus. description. *Eng. Rec.*, Nov. 21, 1891, p. 399.

See *Aqueduct, Plate Girder*.

*Riveted.* The Designing of, with investigation as to distribution of web stress and discussion on reamed rivet holes. By A. F. Hill. *Eng. News.*, Apr. 8, 1888, p. 109.

*Types of Iron Girder, Indian Midland R. R.* A series of plates giving elevations, plans and details of types of iron girder in use on the Indian Midland R. R., India. *Ind. Eng.*, Aug. 25, et seq., 1888.

**Bridges, Highway.**

*Building of.* By J. O. Wright. Discusses the present practice of building highway bridges and gives hints for improvements. *Rpt. Ill. Soc. Eng. & Surv.*, 1888, pp. 60-65.

*Highway Bridges, Construction, Maintenance and Repair.* By S. A. Buchanan. A very valuable paper, which points a way to the solution of the highway bridge problem. Supervision by a local engineer, with detailed plans and specifications, aided by a superintendent of repairs. A rational and efficient scheme which has been in successful operation for many years. *An. Rpt. of Ohio Soc. Eng. & Surv. for 1888*. C. N. Brown, Secretary, Columbus, O.

*Design of.* By M. J. Butler. Attempts a practical treatment, and endeavors to make plain some of the principles of design. *Proc. Prov. Land. Sur. of Ontario for 1887*.

By James Owen. A paper of much value to the young engineer, since the practical results from an experience with some 500 bridges of all sizes is given in the paper. Illustrated. *Trans. A. S. C. E.*, Vol. XI. (1882), p. 277.

*Improved.* By J. H. Burnham. Discusses the improvements made in highway bridges. The discussion on the paper relates mostly to the use of brick in place of stone. *Rpt. Ill. Soc. Eng. & Surv.*, 1888, pp. 47-54.

*Iron Viaducts for Highways.* A valuable paper by J. A. L. Waddell, C. E., of Kansas City, Mo. Published in pamphlet form, by Selden G. Spencer, Kansas City, Mo., June 1889.

*Nova Scotia.* By M. Murphy. Illustrated article, *R. R. Gaz.*, May 3, 1888.

*Old Wooden Highway at Waterford, N. Y.* A typical Burr truss span, 200 feet built in 1801, and still in use. Fully illustrated. *Eng. News*, June 1, 1889.

*Overhead, N. Y. C. & H. R. R.* Gives details of the 60-ft. span overhead highway bridge erected in New York City. *R. R. Gaz.*, Nov. 9, 1888.

*Short Span.* By S. A. Buchanan. Discusses the construction, maintenance and repairs of short span highway bridges. *Rpt. Ohio Soc. Eng. & Surv.*, 1888, pp. 184-194.

*Supervision for New York.* Proposed system of supervision. Paper by Chas. F. Stowell, M. Am. Soc. C. E. *Eng. News*, March 22, 1890, Vol. XXIII., p. 269, et seq.

*Types.* Drawing, with dimensions of two types of highway bridges, built by the N. Y., N. H. & H. R. R. *R. R. Gaz.*, Oct. 28, 1887.

See *Bridge Designing. Bridges, Draw.*

**Bridges, Railroad.**

*Bridges and Culverts.* Detailed drawing of a number of bridges and culverts recently constructed on the Eastern and Midland R. R., England. *Lon. Eng.*, Jan. 14 and 21, 1887.

*Iron.* A description of those recently erected on a new English road, which may be taken as modern English practice. Two plates. *Proc. Inst. C. E.*, Vol. LXXXII., p. 348.

**Bridges, Railroad, continued.**

*Recent Construction of.* A paper by James Ritchie. Includes a table of weights per foot of actual bridges of various spans. *Four. Assn. Eng. Soc.*, Nov., 1890, pp. 511-17.

See *Bridge Floors*.

**Bridges, Suspension.**

By C. Bender. Traces the successive improvements in their mode of construction. *Trans. A. S. C. E.*, also *Van Nos. Eng. Mag.*, Vol. IV., p. 594.

*Of Any Degree of Stiffness.* By C. B. Bender. Gives the theory of equilibrium of a loaded elastic beam suspended from an elastic parabolic catenary. *Van Nos. Eng. Mag.*, Vol. XXV., p. 399.

**Brooklyn Bridge.**

*Chatham Street Extension of the New York and Brooklyn.* A description, with plan, elevation and details, of the New York and Brooklyn Bridge. *R. R. Gaz.*, May 13, 1887.

*Enlarging the Capacity of the.* Gives the report of the Board of Experts on the plans for enlarging the capacity of the Brooklyn bridge; also the report submitted to the Board by Mr. A. M. Wellington. *Eng. News*, March 17, 1888.

*Foundations of.* A paper before the Am. Soc. of C. E., by F. Collingwood, giving notes on the caissons of the East River Bridge. *Trans. A. S. C. E.*, paper, No. XXX., also *Van Nos. Eng. Mag.*, Vol. VII., p. 399.

*Masonry of.* By F. Collingwood. A valuable paper, giving details of the masonry work on the towers and anchorages of the East River Bridge. *Trans. A. S. C. E.*, Vol. VI., p. 7.

*Progress of Work at,* June, 1879. By F. Collingwood. Gives numerous details of methods used. *Trans. A. S. C. E.*, Vol. IX. (1880), pp. 162-172.

*Railroad on.* See *Cable Railroads*.

Report of the committee on Terminal Facilities, and the adopted plans for the terminals. *Eng. News*, April 21, *et seq.*, 1888; *R. R. Gaz.*, April 27, 1888; *Eng. & Build. Rec.*, Apr. 21, 1888.

Second annual report of the Chief Engineer of the New York Bridge Co. *Van Nos. Eng. Mag.*, Vol. V., p. 381.

A series of articles compiled from official reports and observation taking up the description of this work from the beginning in 1867. *Eng. News*, Apr. 30, Dec. 17, 1881.

*Grand Avenue Bridge, St. Louis, Mo.* General view and brief description of this handsome suspension bridge. *Eng. News*, June 27, 1891, pp. 610-11. Details of trusses, floor system, and anchorages, *ibid.*, July 18, 1891. General description and detail drawings are also given in *Eng. Record*, June 6, *et seq.*

*Hammersmith.* A two-page plate showing plan and elevation; also cuts showing details of towers, chain saddles and anchorages. *Lon. Engineer*, April 22 and 29, 1887. Details of construction of towers and roadway suspension connectors, also details of pier foundations, chains and anchorage. *Lon. Engineer*, May 20, 1887.

*Iron Suspension Bridge at Harpers Ferry.* Illus. *C. E. & Arch. Jour.*, 1857, p. 156.

*Minneapolis Suspension.* By T. M. Griffith. Gives brief description of the old and new bridges. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 248.

*Minneapolis.* A paper by F. W. Cappelen, read before the Engrs. Club, Minneapolis, describing in detail this early structure. *Four. Assn. Eng. Soc.*, Aug., 1891, pp. 400-26.

*Monongahela.* Detailed description with historical sketch. By Col. S. M. Wickersham before the Engrs. Soc. West. Pa. *Eng. News*, May 26, 1883, pp. 243-4.

**Bridges, Suspension, continued.***Niagara.*

The reinforcement of the anchorage and renewal of the suspended superstructure of the Niagara Railroad Suspension Bridge. By L. L. Buck. An elaborate paper of 34 pp. fully illustrated, describing a very important work. *Trans. A. S. C. E.*, Vol. X., (1881), p. 195.

*Replacing Towers of.* By L. L. Buck, before the American Society of Civil Engineers. Gives details of the work of replacing the stone towers of the Niagara suspension bridge with iron towers. *Trans. A. S. C. E.*, Vol. XVII. (Oct., 1887), pp. 204-212. *Lon. Engineer*, Dec. 9, 1887; *Lon. Eng.*, Dec. 9, 1887; abstracted *Proc. Inst. C. E.*, Vol. XCIII., pp. 510-512. *R. R. Gaz.*, Nov. 4, 1887, *Eng. News*, Dec. 10, 1887.

*North River, Proposed.*

By G. Lindenthal. Gives brief description of the proposed bridge, also gives a full page plate comparing the bridge with four of the greatest bridges in the world. *Eng. News*, Jan. 14, 1888, and *Eng. & Build. Rec.*, Jan. 14, 1888.

By Gustav Lindenthal, before the American Society of Civil Engineers. Gives very full details of the proposed bridge over Hudson River, at New York. Proposed dimensions are: River span, 2,850 feet; two shore spans, 1,800 feet; width, 68 feet, with six railroad tracks; height above water, 145 feet. Abstracted in *Eng. News*, Jan. 28, et seq., 1888.

*Pittsburgh, Repairing the Cables of.* By F. Collingwood, M. I. C. E. A detailed account of the cause and extent of the rusting of the wires, and the methods adopted to repair them. *Proc. Inst. C. E.*, 1884, Vol. LXXXVI. *Eng. News*, Aug. 2, 1884.

*Point Bridge, Pittsburg.* Description and account of test. *Eng. News*, Apr. 14, 1877, pp. 89-91.

Replacing the cable by links on the Albert Bridge, London, the cable having rusted until the bridge is considered unsafe. Cuts showing the design; also four other systems. *Lon. Engineer*, Dec. 4, 1885.

*Rope Bridges and Their Military Applications.* Brief article discussing the best form of military bridge and illustrating one form of rope bridge. From *Le Genie Civil. Sci. Am. Sup.*, No. 824, Oct. 17, 1891, pp. 13163-4.

St. Ilpize and at Lamothe. By M. Nicou. *Annales des P. & C.*, 1885, Oct., pp. 660-683.

*Theory of Modern American.* By Prof. C. Clericette. Gives the mathematical theory. *Van Nos. Eng. Mag.*, May, Vol. XXIII., p. 111.

*Vishwamitri River.* Short description and abstract from specifications of a chain suspension bridge of 190 feet span, with two large plates showing elevation and details. *Ind. Eng.*, Dec. 10, 1887.

See *Bridge Accidents. Cables.*

**Bridge Trestle.**

*Approaches to Arthur Kill.* Description and detail illustrations of the trestle approaches. The approaches consist of about 6,600 feet of framed trestles and some 3,000 feet of pile trestle. *R. R. Gaz.*, July 26, 1889. Vol. XXI. p. 489.

*Cluster Bent.* By J. A. Hanlon. Gives details of a high trestle near Flushing, O., constructed on the cluster bent plan; shows plan and cross-sections. *Eng. News*, Dec. 31, 1887.

*In Deep Water in Halifax Harbor.* Water 80 ft. deep. Trestle weighed down by rock. Fully illustrated. *R. R. Gaz.*, April 9, 1886.

*High Trestles of the Esquimalt & Nanaimo Railway.* On 10 degree curve. Drawing of a center bent, 152 ft. high, with details. *R. R. Gaz.*, Feb. 6, 1891, p. 89.

*Iron Joint Plates in.* Gives detailed drawings showing the use of iron plates in stead of tenons, etc., as used in the construction of a trestle on the N. Y. L. E. & W. R. R. *Eng. News*, Nov. 5, 1887.



**Bridge Trestle, continued.**

*McCoy's Creek, Fla.* Description of pile trestle for which piles 130 ft. long were driven. Method of driving described. *Eng. News*, pp. 133-4.

*Novel Form.* Brief description, with plan, elevation, and cross-section, of a novel form of trestle used on the L. & N. R. R. *Eng. News*, Oct. 29, 1887.

*Pile and Trestle.* By A. F. Robinson. Discusses the use of pile and trestle bridges, and gives design of the standard trestle of the Chicago, Burlington & Northern Railroad Company. *Eng. News*, April 7, 1888.

*Pile and Trestle Bridges, Construction of.* A paper read by A. Amos before the N. W. Track & Bridge Assoc. Abstract giving arrangement of details. *Ry. Rev.*, Oct. 4, 1890, p. 582.

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**Car Heating, continued.**

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**Sewall System.** By C. P. Kerr. A very full description of the system, with drawings showing details, coupling, traps, etc. *Sci. Am. Sup.*, Dec. 24, 1887; *R. R. Gaz.*, Jan. 20, 1888.

**Steam.**

**Experiments on.** A paper by Prof. Lanza, before the April meeting of the New England Railroad Club. Giving details of experiments made to determine the amount of steam used in heating passenger cars, with discussion. *R. R. Gaz.*, April 20, 1888; *Mast. Mech.*, May, 1888; *Nat. Car & Loco. Build.*, May, 1888.

Gives tabulated results of experiments in continuous heating, from reports collected by the Committee of the Master Car-Builders' Association. *R. R. Gaz.*, June 22, 1888; *Eng. News*, June 30, 1888.

**Notes.** By W. F. Baldwin. A paper before the American Society of Mechanical Engineers. Gives experience gained while making experiments on the Long Island Railroad. *Eng. & Build. Rec.*, May 12, 1888; *Am. Eng.*, June 20, 1888; *Eng. News*, Aug. 18, 1888.

**In Germany and Sweden.** Gives good description of the practice of heating cars by steam in Germany and Sweden. *Mast. Mech.*, Nov., 1887.

**On the Boston, Revere Beach & Lynn R. R.** Description of the system of continuous steam heating being used on the the Boston, Revere Beach & Lynn R. R. *R. R. Gaz.*, Nov. 4, 1887.

**On the C., M. & St. P. R. R.** Gives description and detailed drawings of the couplings of the Gibbs system of steam heating now being tested on the C. M. & St. P. R. R. *R. R. Gaz.*, Jan. 13, 1888; *Eng. & Build. Rec.*, Jan. 21, 1888.

**Pennsylvania R. R.** Full description of system employed, by Theo. N. Ely. Illustrated. *Four. Frank. Inst.*, Nov., 1890; *Ry. Rev.*, Nov. 8, 1890, pp. 668-9; *Eng. News*, Nov. 15, 1890, pp. 445-6.

Review of the different systems for heating cars by means of steam from the locomotive. By W. A. Smith, before the December meeting of the Western Railway Club. Illustrated by cuts of the different styles of couplings. *Mast. Mech.*, Jan. 1888, also *Am. Eng.*, Dec. 28, 1887.



**Car Heating, continued.**

*Steam Heated Water.* Abstract of a paper by W. S. Johnson, read before the Western Ry. Club, advocating a system in which steam heated water is used. *R. R. Gaz.*, June 5, 1891, p. 385. *Eng. News*, June 6, 1891, p. 549.

*Steam Loop.* Illustrated description of a new and valuable invention for automatically returning condensed steam to the boiler. *Eng. News*, Aug. 2 1890, p. 106; *Am. Eng.*, Aug. 20, 1890, p. 79.

*Winter's Lesson.* By Geo. Gibbs, before the April meeting Western Railway Club. Discusses steam heating in the light of the experience of the past winter. *Mast. Mech.*, May, 1888; *Nat. Car & Loc. Build.*, May, 1888; *R. R. Gaz.*, April 20, 1888.

*Temperature Regulator. Tests of the Consolidated Car Heating Co.'s Automatic Temperature Regulator.* Brief account of a very satisfactory test. *Eng. News.*, May 16, 1890, p. 469.

*Theory and Practice.* Report of 25 pp., by Prof. Lanza, giving theory and present practice. An important paper. *An. Rpt. R. R. Commissioners of Mass.*, 1889.

*Timlin Heidinger System.* Illustrated description of the system in use on the Ill. & St. L. R. R. The Timlin-Heidinger system has been in operation on this road since October, 1887. With temperature at 10 degrees below zero is said to heat cars to 70 degrees in fifteen minutes. No perceptible increase in fuel consumption on locomotive has been noticed, or any decrease in the motive power. *R. R. Gaz.*, Dec. 7, 1888.

*Ventilating and lighting.* Paper by J. D. Barnett. Covers 32 pp., including discussions. *Trans. Can. Soc. C. E.*, Vol. I. (1887), p. 72.

*Westinghouse Car Heating System.* Illustrated description of the. *Eng. News*, Jan. 26, 1887.

**Car Journals.** See *Car Lubrication*.

**Car Lighting.**

*Comparative Merits of Various Systems of Car Lighting.* A series of articles taking up the three systems of lighting, oil lamps, compressed oil gas, and air gas from gasoline—and investigating the nature and efficiency of illuminant, cost of construction and operation of plant, etc., and safety of the system. *Eng. News*, April 18, 1891, pp. 362-3, *et seq.*, running up to April 16, 1892.

*Description of Various Systems.* Abstract of a paper by Geo. Gibbs, read before the Western Railway Club describing various systems and discussing questions of safety, cost and relative advantages. A valuable paper. *R. R. Gaz.*, March 6, 1891, pp. 158-60. Paper given in full in *Ry. Rev.*, March 7, 1891, pp. 152-3, 6-7. *Eng. News*, March 7, 1891, pp. 234-5, *et seq.* *Mast. Mech.*, April, 1891, pp. 47-8, *et. seq.*

**Electric.**

*Electric.* By T. P. Carswell. Describes a proposed system of electric lighting for trains. *Lon. Eng.*, Sept. 23, 1887.

Paper read before the American Institute of Electrical Engineers at its June meeting in New York, by G. W. Blodgett, Electrician of the Boston & Albany Railroad. Describes various methods, especially that in use on the B. & A. Railroad, employing storage batteries. *R. R. Eng. Jour.*, Oct. 1887. *R. R. Gaz.*, April 15, Sept. 9, 1887.

A paper by Mr. Charles Selden, Supt. of Telegraph, Baltimore & Ohio. The paper reviews three systems, and gives a detailed statement of the cost of equipment and subsequent operation. *R. R. Gaz.*, October 25, 1889. Vol. XXI., p. 694.

By Wm. Stroudley. Describes a method in use in England, where the motor is geared by belting to the axle of a car. When the train stops the current is supplied from accumulators. Seems to be very simple and successful. *Trans. Inst. C. E.*, Vol. LXXXIII., p. 329.

**Car Lighting, continued.**

A paper by J. A. Timms before the Brit. A. A. S., discussing conditions and requirements. *Elec. Rev.*, Sept. 11, 1891, pp. 315-17.

Treats of lighting cars by electricity, first, by batteries; second, by dynamo machines, with costs of the same. *R. R. Gaz.*, April 15, 1887. A full discussion of the subject by the members of the New England Railroad Club. *R. R. Gaz.*, April 22, 1887.

*C. M. & St. P. Ry.* Description of the light and heat tender designed by G. W. Gibbs, M. E. Plan and sections. Indicator tests. *R. R. Gaz.*, June 13, 1890, pp. 410-2. *Elec. World*, June 21, 1890, pp. 419-20.

*Electric Light Car, Pennsylvania R. R.* Brief description with folding inset. *Eng. News*, Aug. 23, 1890, p. 174.

*On Railway Train Lighting.* A paper by William Langdon describing the general features of electric lighting plants on several English railway trains, and giving some statistics regarding first cost and maintenance. Folding plate showing arrangements. *Proc. Inst. C. E.*, Vol. CVI, 1891, pp. 126-49. Discussion, pp. 150-77.

**Pintsch System.**

*In France.* Gives details of the cost of lighting cars by the Pintsch system in France. *R. R. Gaz.*, Nov. 11, 1887.

*On the Chicago & Northwestern.* Illustrated description of the gas plant at Chicago, and of the method of manufacture. *R. R. Gaz.*, July 24, 1891, pp. 507-8.

*Some Interesting Facts About the Way the Gas is Made.* Brief descriptive article. Illus. Details of compressor shown. *Mast. Mech.*, June, 1891, pp. 82-3.

*Lighting and Ventilation.* Discussion of the above subjects by the New York Railroad Club. *R. R. Gaz.*, Nov. 25, 1887.

**Car Lubrication.**

*English Car Journal Lubricants and Methods of Testing.* An article giving English practice. By an engineer of tests on an English railway. *R. R. Gaz.*, Feb. 14, 1890, Vol. XXII., p. 103.

Extracts from a forthcoming book by Willis E. Hall. Treats of the relation of friction to the size of bearings, and of distribution of pressure. *Eng. News*, June 27, 1891, pp. 622-3.

A paper by W. E. Hall before Engineers' Club, Phila., Nov., 1886. *Proc. Eng. Club, Phila.*, Dec., 1886, Vol. VI., pp. 37-42.

**Car Starters.**

*For Grades.* Flood's. Illus. *Elec. Eng.*, Oct. 29, 1890.

*Theory of.* By J. B. Johnson. Gives mathematical demonstrations for sizes of steel springs and air chambers designed for storing the energy of a moving car. Shows the futility of all steel spring devices, and the unprofitableness of all such schemes. *Jour. Assn. Eng. Soc.*, Vol. IV., p. 293.

**Car Transfer Apparatus, of Robert H. Ramsey.** Report of a committee of the Franklin Institute on its merits, who recommend awarding to the inventor the Elliot Cresson medal. The apparatus described and illustrated. Its purpose is to transfer cars from tracks of one gauge to those of another. *Jour. Frank. Inst.*, September, 1886.

**Car Trucks.**

*Barber Roller Bearing Truck.* A description with drawings of a very satisfactory truck in use on the Northern Pacific. A lateral movement of one inch is allowed. *R. R. Gaz.*, Feb. 20, 1891, pp. 124-5.

*Fox Solid Pressed Steel Freight Truck.* Description of this new form of truck. *R. R. Gaz.*, March 27, 1891, pp. 210-11.

**Car Trucks, continued.**

*Passenger Car Truck.* Gives detailed drawings with dimensions of a passenger truck with eight brake shoes. *R. R. Gaz.*, Dec. 9, 1887.

*Six-Wheel Trucks for Freight.* By J. M. Barr, before the March meeting of the Western Railway Club. Discusses the use of the collarless axle, and advocates the use of six-wheel trucks for freight cars of 60,000 lbs. capacity. *Mast. Mech.*, April, 1888; *R. R. Gaz.*, March 23, 1888; *Nat. Car. & Loc. Build.*, April, 1888.

*Swing Beam Trucks.* Discussion at the Oct. meeting of the Western Railway Club, *Ry. Rev.*, Nov. 8, 1890, pp. 664-5. Abstract in *Eng. News*, Nov. 8, 1890, p. 419. *Ry. Rev.*, Nov. 15, 1890, pp. 681-2. *R. R. Gaz.*, Nov. 14, 1890, pp. 781-2.

*Swing Motion and Rigid Trucks.* Discussion at Nov. meeting of New Eng. R. R. Club. *R. R. Gaz.*, November 21, 1890, pp. 802-3. *Ry. Rev.*, Nov. 22, 1890, p. 696.

**Car Vestibule.** *Barr's Vestibule, Chicago, Milwaukee & St. Paul Railway.* Description with detail drawings. *R. R. Gaz.*, July 17, 1891, pp. 492-3.

**Car Wheels,**

*And Axles for 60,000-lb. Freight Cars.* Discussion of the subject before the New York Railroad Club, at the December meeting. Discussion opened by a paper on the subject by Mr. G. N. Barr. Also editorial notes on same. *R. R. Gaz.*, Dec. 28, 1888; *Mast. Mech.*, Jan. 1889.

*And Axles, Their Relation to the Track.* A discussion by the members of the New England Railroad Club at its February meeting. Relates mainly to the relative merits of steel and cast-iron wheels. *Mast. Mech.*, March, 1888; *R. R. Gaz.*, Feb. 17, 1888; *Nat. Car & Loco. Build.*, March, 1888.

*And Contracting Chills.* A discussion before the Northwest Railroad Club, in which this subject is thoroughly discussed. *Mast. Mech.*, Dec., 1889, Vol. IV., p. 211.

*And Tires.* By C. F. Allen, before the March meeting of the New England Railroad Club. Discusses the question of safety in the use of wheels and tires. Followed by discussion. *Mast. Mech.*, April 1888. *Nat. Car & Loco. Build.*, April, 1888; *R. R. Gaz.*, March 23, 1888.

*Best Diameter of.* A paper by Samuel Porcher, discussing the subject and giving the results of his experience. Read before the New York Railroad Club. *R. R. Gaz.*, Feb. 27, 1891, pp. 139-40; *Ry. Rev.*, Feb. 28, 1891, p. 136.

*Conical Tires on Railway Rolling Stock* a cause of resistance to traction (6 to 20 per cent.) and a supposed cause of the creeping of rails. Abstracted from the German. Highly Mathematical. *Proc. Inst. C. E.*, Vol. LXXXVI., p. 410.

*Cushion Car Wheel.* Description with drawings of wheel having a cushion of rubber between the tire and wheel center. *R. R. Gaz.*, Sept. 4, 1891, p. 613.

*Cylindrical Wheels and Flat Topped Rails for Railways.* A paper by D. J. Whittemore, M. Am. Soc. C. E., objecting to the usual form of rail, and proposing to substitute a flat topped rail exactly fitting the tread of the wheel. Pp. 19; plates, 7. *Trans. A. S. C. E.*, Sept., 1889, Vol. XXI., p. 133.

See *Iron, Car Wheel, Microscopic Structure of.*

**Guarantees.**

Article by P. H. Griffin discussing report of M. C. B. Committee. *R. R. & Eng. Jour.*, Sept., 1891, pp. 394-95.

Three valuable papers presented to the February meeting of the New York Railroad Club, on the guarantee for car wheels, mileage of steel-tired wheels and the safety of cast-iron wheels. *Mast. Mech.*, March, 1888; *R. R. Gaz.*, Feb. 24, 1888.

Lecture by Rob. W. Hunt at Cornell University. This is a valuable and complete discussion of American car wheels. Illus. *Sci. Am. Sup.*, Nos. 761, 762, Aug. 2 and 9, 1890, pp. 12156-8, 12171-3.

**Car Wheels, continued.**

*Machine for Rolling.* Illustrated description of a machine designed by J. R. Jones of the Pencoyd Iron Works. *R. R. Gaz.*, Oct. 9, 1891, pp. 704-5. *Ry. Rev.*, Oct. 31, 1891, p. 712. *Iron Age*, Sept. 24, 1891, pp. 493-4.

*Machined.* An interesting pamphlet describing the method of manufacturing machined wheels. Illus. Issued by the N. Y. Car Wheel Co., Buffalo, N. Y. Extended extracts in *Eng. News*, July 12, 19, 1890, pp. 40, 49.

*Sections and Mechanical Conditions of.* Abstract of a paper by P. H. Griffin read before the Am. Soc. C. E., discussing the question of proper action, methods of manufacture, and mechanical defects. Illus. *Eng. News.*, June 27, 1891, pp. 612-14. *R. R. Gaz.*, June 12, 1891.

*Specification for Cast-Iron.*

Gives specifications for cast-iron car wheels, as proposed by Mr. Barr before the Western Railway Club. *R. R. Gaz.*, Dec. 23, 1887; *Mast. Mech.*, January, 1888.

M. C. B. specification for cast-iron car wheels. Specifications respecting both materials and testing are given. *Ry. World*, July 13, 1889; *R. R. Gaz.*, July 5, 1889; *Proc. M. C. B. Ass'n.*, Auraloga, 1889, p. 82.

*Steel, Richards' Process for Casting.* A special method of moulding producing a very sound wheel. Illustrated description. *R. R. Gaz.*, June 5, 1891, pp. 386-8.

*Steel Tired and Chilled.* Extract from the report of the Massachusetts Railroad Commissioners on the Haverhill Accident, showing the kind of wheels in use in Massachusetts. *R. R. Gaz.*, May 11, 1888; *Nat. Car. & Loco. Build.*, June, 1888; *Eng. News*, May 19, 1888.

*Steel Tired Wheels and the Ross-Mehan Shoe.* Discussion at New Eng. R. R. Club meeting. *R. R. Gaz.*, Oct. 18, 1890, p. 247; *Eng. News*, Oct. 18, 1890, p. 347; *Ry. Rev.*, Oct. 18, 1890, p. 616.

Table showing percentages of wheels removed in 1884 for various causes. 18,000 wheels removed out of a total of 300,000, from 24 different makers; with editorial discussion of the lessons to be learned from this remarkable exhibit. *R. R. Gaz.*, June 5 and 12, 1885.

*Testing of.* A paper by P. H. Griffin, read before the N. Y. R. R. Club. This paper gives an account of the methods of testing employed at the N. Y. Car Wheel Works, and some excellent results attained in the strength of their cast iron. *R. R. Gaz.*, March 6, 1891, pp. 160-1; *Ry. Rev.*, March 7, 1891, p. 150.

*Tire Testing,* Woehler's experiments on. An editorial abstract. *R. R. Gaz.*, Sept. 2, 1887.

"*Truing up old Car Wheels in Five Minutes.*" A description and illustration of a remarkable new machine for truing up both cast-iron and steel car or locomotive wheels. *Mast. Mech.*, Jan., 1890, p. 13.

See *Wheels*.

**Cars.**

*American Cars for the Southeastern Railway, England.* Description with inset of drawings of some handsome cars recently built for the above railway. *Eng. News*, Oct. 10, 1891, pp. 338-40, Oct. 17, p. 367.

*Best Size of Freight.* A good editorial on the subject. The conclusion reached is that "a short car cheaply handled at the termini will, on a short haul, convey freight more cheaply than a large car. On a long haul the terminal charges have little influence on the total cost, and the car that carries the greatest load appears the cheapest." *R. R. Gaz.*, April 8, 1887.

*Canada's Cattle.* Gives description, with plans, elevation and cross-section, of Canada's cattle cars. They are provided with hayracks, water-troughs and movable partitions. *R. R. Gaz.*, March 2, 1888.

*Coal, 60,000 lbs. Capacity.* Gives drawings of a 60,000 lbs. capacity coal car for the Georgia Pacific Railroad. *Nat. Car & Loco. Build.*, June, 1888.

## Cars, continued.

**Combination.** Systems in use on railroads in Belgium and in Rhenish Prussia. *Annales des P. & C.*, 1884-2-635.

**Derrick, 10-Ton.** *Baltimore & Ohio Railroad.* Standard Derrick Car. Description and drawings, *R. R. Gaz.*, Jan. 9, 1891, pp. 23-4.

**Dining.** Gives plan, cross-sections and specifications for a dining car for the Michigan Central R. R. *R. R. Gaz.*, Aug. 19, 1887.

**Draft Rigging for Freight Cars: Denver & Rio Grande Railroad.** Continuous throughout the entire length of the car. Very serviceable. Illustrated description, *Ry. Rev.*, April 25, 1891, pp. 263.

**Draw-Bar Rigging for Freight Cars.** Discussion before meeting of Western Railway Club. Also an illustrated description of the Graham draft rigging in use on the Pennsylvania R. R. *R. R. Gaz.*, March 29, 1889.

**Dump.**

**Side Dump Car.** Eighty thousand pounds capacity. New York, Lake Erie and Western R. R. A complete description of this novel and convenient form of side dump car, with inset drawings in detail of same. *Eng. News*, April 19, 1890, Vol. XXIII., p. 369.

**Standard Dump Car.** Boston and Albany Railroad. Plan, elevation, end elevation and section giving dimensions and details. *R. R. Gaz.*, March 7, 1890, Vol. XXII., p. 157; *Ry. Rev.*, March 8, 1890, p. 135.

**Fifty-Thousand Pounds.**

**Standard.** Gives brief description with drawings and bill of material, of the standard 50,000-lb. freight car of the Lehigh Valley Railroad. *R. R. Gaz.*, June 8, 1888.

**Standard 50,000 lbs. Freight Car.** for Chicago & Northwestern Ry. Description, complete details and weights of parts are given. *R. R. Gaz.*, Jan. 10, 1890, Vol. XXII., p. 19.

**Gondola, Standard 50,000-lb.** Gives detailed drawing, with abstract from specifications for the standard 25-ton gondola car of the Newport News & Mississippi Valley Co. *R. R. Gaz.*, April 6, 1888.

**Twin Hopper 60,000-lb.** Gives description, with bill of lumber and detailed drawing, with dimensions, of a twin hopper bottom gondola car having a capacity of 60,000 lbs. recently constructed for the Lehigh Valley Railroad. *R. R. Gaz.*, Sept. 14, 1888.

**Freight.** An essay by W. R. Brown on the construction of the best form of freight cars with special reference to economy in dead weight. *Van Nos. Eng. Mag.*, Vol. XVI., p. 135.

**Freight Depreciation of.** Gives a table showing the value of a freight car at any age, estimated at 6 per cent. per annum as per Master Car Builders' rules. *R. R. Gaz.*, April 27, 1888.

**Grain Weighing and Transfer Car.** Description and drawings. *Ry. Rev.*, June 6, 1891, pp. 358-9.

**Iron.** A short article making comparison between iron and wooden railway cars favorable to the adoption of the former. *Am. Mfr.*, Nov. 30, 1888.

**Iron. Uses of in Freight Car Construction.** A paper by G. W. Ettinger, read before Western Railway Club with discussion. *R. R. Gaz.* Nov. 30, and *Mast. Mech.*, December, 1888.

**100,000-lb. Car, Penn. R. R.** Gives drawing, showing details of a car of 100,000 lbs. capacity, designed for carrying cables for street railroads, and built for the Pennsylvania Railroad. *R. R. Gaz.*, May 11, 1888.

**Ore.**

**Twenty-five Ton Iron Ore.** Gives a two-page plate of detailed drawings of a twenty-five ton iron ore car used on the Swedish Railroad. *Lon. Engineer*, April 27, 1888.

**Cars, Ore, continued.**

*Wisconsin Central Ore Cars—60,000 lbs. Capacity.* Description with detailed drawings. *Ry. Rev.*, Oct. 17, 1891, p. 673. Brake rigging of these cars illustrated in *Ry. Rev.*, Oct. 24, 1891, p. 690.

*Pullman Vestibule Sleeping.* General and detail drawings and description. *R. R. Gaz.*, Nov. 23, 1888.

*Thirty-Ton Combination Car, Chesapeake & Ohio Railway.* Illustrated description. *R. R. Gaz.*, Feb. 1, 1889.

**Sixty Thousand Pounds.**

*Union Pacific Railway.* Description, principal dimensions, details of truck, etc. *Ry. Rev.*, April 12, 1890, Vol. XXX., p. 204.

*Michigan Central Standard Car and Truck.* Description with drawings. *Ry. Rev.*, Oct. 11, 1890, pp. 598-600.

Standard dimensions, forms of construction, etc., adopted by the Master Car-Builders' Association, with discussions on the same. See *Proc. M. C. B.* 20th annual convention.

**Steel.**

*Harvey Steel Car.* Description with drawings of this new car, built for the C. B. & Q. R. R. *Ry. Rev.*, Nov. 1, 1890, pp. 650-1, Dec. 13, p. 747.

Illustrated description of a new form of car built of steel, asbestos, iron pipe and wood. *R. R. Gaz.*, Jan. 4, 1889.

*Schoen Pressed Steel Car.* Description and details of this somewhat novel car. *R. R. Gaz.*, May 23, 1890, p. 352.

*Stock Car.* Detail drawings with description of the new Harvey Steel Car. *Eng. News*, July 11, 1891, pp. 24-5.

*Thirty Ton Steel Cars—Belfast and Northern Counties Railway, Ireland.* Designed for ore carrying. Both car and truck have steel frames. Description and drawings. *Ry. Rev.*, Aug. 15, 1891, pp. 534-5.

**Cast Iron.** See *Iron, Cast.*

**Castings.**

*Defects in Structural Castings.* By Thos. D. West. Gives many valuable facts concerning the design and execution of such work. *Four. Assn. Eng. Soc.*, Vol. II., p. 247.

*New Process of Making Ornamental Castings.* Consists in lining the inside of the mould with carbonized lace or other textile fabric. Abstract of remarks made at the meeting of the Franklin Institute, April 20, 1887. By A. E. Outerbridge, Jr., *Four. Frank. Inst.*, June, 1887, Vol. CXXIII., No. 733. Report of Franklin Institute Committee on same. *Four. Frank. Inst.*, Nov., 1887, Vol. CXXIV., No. 743.

*Sound.* A paper by Thos. D. West, with discussion. Furnishes considerable valuable information to engineers as to the causes of defects in castings and their remedies. *Trans. A. S. M. E.*, Vol. VI., p. 91.

**Cattle Guards.** See *Railroad Structures.*

**Cement Barrels.** *Cubic Contents of.* Table exhibiting the cubical contents of the barrels used by nine cement manufacturers. *Eng. News*, Feb., 22, 1890, Vol. XXIII., p. 185.

**Cement Laboratory of the St. Louis Water-works Extension.** An article by S. Ben Russell, describing apparatus used and methods of testing. Illustrated. *Eng. News*, Jan. 3, 1891, pp. 2-4.

**Cement Tests.**

*Carried on in the Department of Engineering, State University of Iowa.* Many tests are recorded, and comparisons made between specimens hardening in air and those hardening in water. *The Transit*, Dec., 1890, pp. 7-40.

*Different Forms of Briquettes.* By J. E. Codman before the Philadelphia Engi-

## Cement Tests, continued.

neers' Club. Gives results of testing cement in different forms of briquettes. *Proc. Eng. Club, Phila.*, December, 1887, Vol. VI., pp. 168-72.

*Experiments with Testing Appliances* By Alfred Noble. On Sault Ste. Marie Canal Locks, with discussion. Illustrated. *Trans. A. S. C. E.*, Vol. IX. (1880), pp. 186-201.

*Hints on.* A paper read before the Engrs. Club of St. Louis. Discusses relative importance of various tests, especially that of fineness. *Four. Assn. Eng. Soc.*, Sept., 1891, pp. 455-60.

*How to Test the Strength of Cements* By J. Sondericker. Gives a description of an apparatus for testing cements, and presents some of the results obtained. *Four. Assn. Eng. Soc.*, June, 1888, Vol. VII., pp. 207-22. Also *Trans. A. S. M. E.*, Vol. IX. (1888), pp. 172-84.

*Long Time Tests.* An answer, by experiments extending over six years, for Boston Main Drainage Works, of many questions relating to the use of cement. *Trans. A. S. C. E.*, Vol. XIV., p. 141. Also in *Eng. News*, July 4, 1885. Illustrated.

Gives data derived from breaking 200 briquettes at dates varying from 7 to 2,019 days of gauging. *San. Eng.*, July 2, 1887.

*Methods.*

By Edmund Yardley. Gives the methods employed and results obtained in testing cements for the Pennsylvania Railroad. *Trans. A. S. C. E.*, Vol. II. p. 153.

Answers to eight queries by the government chemist on methods of testing (should be tested wet) relative strength of Portland and light burned cements, effects of alumina, magnesia, alkali, sulphuric acid. *Eng. News*, Dec. 26, 1885.

*Microscopic Method.* Account of a microscopical examination of some cements, with discussion as to the value of the method. Illustrated. By Alden H. Brown, in *The Transit*, of the Univ. of Iowa. Reprint, *Ry. Rev.*, Nov. 7, 1891, pp. 726-7. *Eng. News*, Nov. 21, 1891.

*Neat Tests vs. Sand Tests for Portland Cement.* A paper by S. Bent Russell, discussing the results of a large series of experiments made for the St. Louis Water Works. Describes also a machine for mixing briquettes. Illustrated. *Trans. A. S. C. E.*, Vol. XXV., Sept., 1891, pp. 293-300. Discussion, pp. 300-4.

*New Croton Aqueduct.* Gives profile showing strength of cements used in the construction of the new Croton Aqueduct. *Eng. & Build. Rec.*, Aug. 18, 1885.

*Notes and Experiments on the Use and Testing of Portland Cement.* By Wm. W. Maclay. An exhaustive paper of great merit, giving principles for both testing and using. Illustrated. Received the Norman medal. *Trans. A. S. C. E.*, Vol. VI. (1877), pp. 311-64. Discussion, Vol. VII., p. 274, where cement tests for East River Bridge are given; also, p. 280.

*Portland Cement Testing.* By I. J. Mann, before the Institution of Engineers. Treats of the color, weight, pulverization, and tensile strength of Portland cement. *Van Nos. Eng. Mag.*, Vol. XVII., p. 17.

By T. Guillaïn. Gives details of the specification for the supply and testing of Portland cement used for harbor work at Calais and Boulogne. *Nouvelles de la Construction*, Vol. III., p. 88; *San. Eng.*, July 9, 1887; *Eng. News*, Sept. 3, 1887.

By H. Faija, before the American Society of Civil Engineers. Gives details of the method employed by himself for a number of years; shows details of apparatus for mixing and testing cements. *Trans. A. S. C. E.*, Vol. XVII., November, 1887, pp. 218-28.

*On the Mechanical Examination and Testing of Portland.* By Henry Faija.



**Cement Tests, continued,**

Considers details of manipulation and other matter affecting results in a cement test, and then the properties which a good cement should show. *Van Nos. Eng., Mag.*, Nov., 1884.

Very elaborate, both as to times allowed for setting and as to composition. Results plotted. Very valuable record. *Rep. Chf of Engrs.*, 1883, Vol. II., p. 1849.

**Standard.**

*German Specifications for Standard Portland Cement Tests.* Translated for the Testing Laboratory of Cornell University. Many of the requirements will appear novel to American readers. *Eng. News*, Nov. 13, 1886.

*New German (1887) Standard Rules* in. *Proc. Inst. C. E.*, Vol. XC., p. 474.

Report of a committee of the Am. Soc. of Civ. Engrs., prescribing a series of "standard tests" for fineness, checking, or cracking, and tensile strength. It would seem to be well for all tests in America to be made by the methods here prescribed in order to enable intelligent comparisons to be made. *Trans. A. S. C. E.*, Vol. XIV., p. 475, also in *Eng. News*, Dec. 19, 1885.

**Tensile.** An appliance for more accurate determinations. By D. J. Whittemore. With discussions. Illustrated. *Trans. A. S. C. E.*, Vol. IX. (1880), pp. 329-47.

**Wet and Dry Sand.** A table showing the great increase in bulk of sand, due to the addition of a small amount of water, and hence the variation in the quality of mortar from using wet sand. From Lon. *Engineer. Eng. News*, Feb. 21, 1891, p. 173.

**Cement-Testing Machine.** Home-made, at a cost of ten or twelve dollars. Seems to work satisfactorily. Full detail drawings given. *Proc. Eng. Club, Phila.*, Vol. V., p. 194.

**Cement Works.**

**On the Lehigh.** Brief description of the cement (Portland and Anchor) works and the deposits, with tables of analyses and results of tests, p. 9. Chap. XII. of Report of Frederick Prime, Jr., *Second Geol. Survey of Pa*, D. D., 1876.

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#### Docks.

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A brief description of the docks and railroad now in course of construction at Barry Island, near Cardiff. The work will consist of a 40-acre and 7-acre basin, also about 18 miles of railroad. *Lon. Engineer*, March 4, 1887.

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## Dock Dry.

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See *Shipyard*.

**Dock-Wall.** Twenty-three feet of water at low tide in front of them, built in form of hollow piers 33'  $\times$  22' in plan, by 27 ft. high, the well-hole 19'  $\times$  8' in plan, sunk by pumping out the water and excavating inside the well-hole, then filled with concrete. The piers set three feet apart and sunk at intervals; first every other one, then the missing ones. Cost of excavation, of net measurement of exterior of the completed piers, including cost of pumping, stagings, lighting, fuel, cost of plant, with cost of repairs and charging whole original cost of plant, inclusive also of all supplementary work, and excluding only cost of masonry laid in cement above ground, but by tide-work, was about \$2.05 per cubic yard; of which price about 63 cts. represents the cost of the plant. *Annales des P. & C.*, 1885-1-96. See also works on the Plantation quay at Glasgow, described in the same journal, February, 1876, and on the Rochefort wet-dock, Feb., 1884.

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By J. P. Frizell. Treats of the reclamation of the submersible lands of the Mississippi Valley. A criticism on the report of the Commission authorized by Congress in 1874. *Van Nos. Eng. Mag.*, Vol. XIII., p. 18.



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*And Sewerage of Hyde Park, Ill.* Report upon. By Benezette Williams and John A. Cole, Civ. Engrs., Chicago. A 60-page pamphlet, with large map. The report based on a careful topographical survey. The project involves many new features. Apply to the authors.

*A Water Supply of Chicago.* See *Water Supply*.

*Of Charleston, S. C.* See *Tidal Drains*.

*Chicago.* Gives extracts from a special report of the Chicago Drainage and Water Supply Commission on the diversion of the flood water of the Desplaines River and the north branch of the Chicago River. *San. Eng. & Const. Rec.*, July 30, 1887.

*Chicago Drainage Problem. The Overflow of the Desplaines River.* Paper by Ossian Guthrie, member Western Society of Engineers; read September, 1889. A valuable paper. P. 17. *Your. Assn. Eng. Soc.*, March, 1890, Vol. IX., p. 77.

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- Oak Orchard and Tonowanda Swamps, New York.* The reclamation of 25,000 acres of swamp land found perfectly feasible at a small cost. The scheme outlined accompanied by maps. *N. Y. State Survey Report*, 1883.
- Problem of Just Apportionment* of cost (of construction of among landholders benefited thereby.) A statement of legal principles involved. By E. B. Opdycke. Also a shorter paper on same subject by J. L. Geyer. *Report Ohio Soc. Surv.*, 1885.
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**Drainage Canal.** *The Rungpur Drainage Canal.* Description with map, of this canal, which is 7 miles long, 29 feet wide at base, and slopes, two to one. *Ind. Eng.*, Oct. 18. pp. 312-3.

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*Near Markdorf, in Bavaria.* Short description of work executed at a cost of \$25,000, consisting of the drainage of swamp lands covering about 865 acres. *Deutsche Bauzeitung*, 1885, pp. 497-9 and 521-3.

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*And Traps.* See *House Drains.*

**Testing of.** An unpatented appliance, readily procured, devised by Charles Hawksley, M. Inst. C. E. Illustrated by cut. Tests soundness of all traps and joints in a house system. *San. Eng.*, March 26, 1885.

**Ventilation and Trapping of.** Abstracted from a paper before the Society of Arts, by James Lovegrove. *Van Nos. Eng. Mag.*, Vol. I., page 731.

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**Drawing Boards. Recent Improvements in.** By Theo. Bergner. A ruler moves parallel to itself over the board by means of pulleys and an endless cord. Its

**Drawing Boards, continued.**

accuracy is practically perfect. Highly recommended by those who have used it. Not patented. Details shown. *Proc. A. S. M. E.*, Vol. VI., p. 224.

**Drawing Table**, Illustration of a cheap and practical form of adjustable drawing table. *Mast. Mech.*, Dec., 1889, Vol. IV., p. 210.

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*Office System for*. By Henry R. Towne. *Trans. A. S. M. E.*, Vol. V., p. 193. *Mechanics*, June and July, 1884.

*Reproduction of, by Actinic Processes*. By Benj. H. Thwaite. Describes many methods, with the necessary mixtures, apparatus and manipulations, including two giving white lines on blue ground; three giving blue lines on a white ground; two giving white lines on a black ground; two giving black lines on a white ground; two giving brown lines on a white ground; also the zincographic process. *Proc. Inst. C. E.*, Vol. LXXXVI., p. 312. See *Heliograph Black Process and Copying Drawing*.

In black on white ground. Sensitized paper used, and process similar to the blue process, but no chemicals needed. *Eng. News*, Nov. 28, 1885.

*Black Process*. A process of reproducing drawings which gives black lines on a white ground. *Building*, March 5, 1887, also *Am. Eng.*, March 16, 1887; *Eng. News*, Dec. 25, 1886.

*By Chemical Processes*. By Robt. Marshall. Gives the ferro-prussiate and cyani-ferric processes of making negative and positive blue prints, with formulas and mode of application. *Sci. Am. Sup.*, Feb. 19, 1887.

*Cyanotype Process of Reproducing*. Gives notes compiled in the Photographic Office Survey of India Department, Calcutta, on the positive cyanotype process of reproducing drawings with dark lines on a clear ground. *Ind. Eng.*, Aug. 4, 1888.

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*Section Lining, Standard*. By T. Van Vleck. Recommends the adoption of standard section to represent the conventional sections of iron, steel, etc., on all engineering drawings. Cuts show the proposed sections. *Eng. News*, Dec. 31, 1887.

*Shades and Shadows in Architecture*. Valuable series of papers by Prof. A. D. F. Hamlin. Illustrated. *Am. Arch.*, Aug. 30, 1890. No. 766, *et seq.*, pp. 130-3. Continued from No. 755, p. 165.

*Workshop*. By Alfred D. Ottewell. Two short articles giving many valuable practical instructions. *Am. Eng.*, Nov. 7 and 21, 1884.

**Dredging.**

*Bristol, England and the West Indies*. Description of a steel, four-screw and single-ladder hopper dredge, 218 feet long, built for the Dock Committee of the Bristol Corporation. Also of a twin screw dredge "Dolphin" for the West Indies. Illustrated with full page drawings. *Lon. Engineer*, Jan. 7, 1887.

*Cost of*. See *Canals, Ship, Lake Erie*.

*Hydraulic, in New York*. Brief description of method of dredging by pumping up the material. *R. R. Gaz.*, Aug. 28, 1891, pp. 593-4.

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*Oakland Harbor, Cal.*, being an account of extensive operations where the material is pumped up and forced through long lines of pipe to the deposit beds. With plate. *Trans. A. S. C. E.* Vol. XIII., p. 9.

*Ocean Bars*. By Gen. A. Q. Gilmore. Gives details of the removal of bar at the mouth of St. John's River by means of sand pumps. *Van Nos. Eng. Mag.*, Vol. VII., p. 311.

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*Operations and Appliances.* By John J. Webster. Gives historic sketch of dredging machines, and a great deal of valuable matter relating to dredging. Discussion of the above paper by prominent engineers. *Inst. C. E.*, Vol. LXXXIX, p. 2; *Eng. News*, July 16 and 23, 1887; *Lon. Eng.*, March 4, 1887.

**Dredging Contracts, Prices of.** A list of prices of the accepted bids on dredging contracts let between Feb. 1888, and Feb., 1889. *Eng. News*, March 23, 1889.

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*Hydraulic.* By C. B. Hunt. Refers briefly to one or two typical machines, and then describes the Von Schmitt system of hydraulic dredging in detail. *Proc. Eng. Club, Phila.*, Vol. VI., p. 124.

*Recent Improvements in.* A paper before the Am. Soc. Mech. Engrs., by A. W. Robinson. Mainly confined to the chain-bucket or elevator system in comparison with others. Illustrated. *Eng. News*, Dec. 4, 1886.

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**Dredges.**

Description, with large detailed drawing, of a twin screw dredge, having a capacity of 400 tons per hour in a depth of 32 feet of water, constructed for Auckland Harbor. *Lon. Eng.*, June 11, 1886.

*Double Ladder, Swansea Harbor Trust.* Gives brief description, with two-paged plate, showing plan, sectional elevation and sections, of a double ladder dredge recently constructed for the Swansea Harbor Trust. Dimensions, 150X41, with 12 hold; capacity 900 tons per hour from a depth of 38 feet. *Lon. Eng.* July 13, 1888.

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*For Use in Shaft Sinking* underwater or for pier foundations. From the French. Illustrated. Buckets on an endless chain; and also by jet operated by forcing air into the elevating tube near the bottom. *Eng. News*, March 6, 1886.

*Hercules Dredges for the Panama Canal.* Illustrated description of these dredgers. *Eng. News*, Feb. 3, 1883, pp. 49-51.

*Hopper Suction Dredge* for Port of Libau. Illustrated description. At test, hopper was filled in 35 minutes with 500 tons of sand and clay, then steamed out to sea and unloaded in a few minutes through bottom doors. *Lon. Eng.*, Jan. 11, 1889.

*Hydraulic.* Works to a depth of 15 feet and excavates 50 tons per hour. Sectional views shown. Bruce and Bathos's system. *Lon. Eng.*, June 12, 1885.

Illustrated description of various machines. *Eng. News*, May 10, 1879, pp. 146-8.

*Lockwood.* Gives description of the dredge designed and built by F. A. Lockwood for work on the Cape Cod Canal. Drawings show details. *San. Eng.*, Nov. 5, 1887.

*Lobnitz Rock-Breaking.* Illustrated description of a dredge for the removal of rock under water by first breaking it into blocks of convenient size, and then lifting these to the surface by a strong chain of buckets. *Eng. News*, Jan. 26, 1889.

*New Canal Excavator.* The dredge is placed upon a truss, the ends of which rest upon trucks. These trucks run on lines of track built along the bank of the canal. Illustrated description. *R. R. Gaz.*, Sept. 25, 1891, p. 669.

*Pumping.* The Badger dredge, as operated at Coney Island, New York, described and illustrated. Seems to be very efficient. *Eng. News*, Jan. 30, 1886.

*Rock, Suez Canal.* An illustrated description of the sub-aqueous rock dredger "Derocheuse," built for the Suez Canal. Its dimensions are 180X40X12 ft. It

**Dredges, continued.**

has ten chisel bars 42 feet long, weighing four tons each, and dredging machinery to remove the broken rock. Its capacity is about 40 tons per hour. *Lon. Engineer*. March 9, 1888.

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*Twin Screw Hopper, "Pholas."* A brief description, with two-page plate showing plan and sections of the dredge boat "Pholas," built for the Bombay Port Trust. The boat is 155 feet long, 31 feet beam, and 10 feet depth molded, built of steel, with 8 compartments; capacity of hoppers, 10,000 cubic feet, with displacement for 500 tons of dredged material. *Lon. Eng.*, June 24, 1887.

*Used on the Panama Canal, of American Manufacture.* A large cut, with description. Capacity, 1,000 cubic yards per hour deposited on the bank. *Sci. Am. Sup.*, Feb. 14, 1885; also *Sci. Am.*, Aug. 15, 1885.

*On Schmidt Dredge.* Description of this form of sand dredger or suction-dredger. Folding plate. By George Higgins. *Proc. Inst. C. E.*, Vol. CIV., 1891, pp. 191-5.

*And Soil Transporter at the Manchester Canal.* Illustrated description of this very efficient machine. From *Lon. Eng. Eng. News*, Sept. 5, 1891, pp. 221-2.

See *Canal Construction*.

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*Holding Power of Drift Bolts and Spikes.* Table of results of a large series of tests made in 1874-7. Extracted from a government report. *Eng. News*, Sept. 26, 1891, pp. 282-3.

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**Drift Mining.**

See *Mining*.

**Drill, Cheap Portable.** See *Appliances*.

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See *Boring*.

**Drilling Machine.** *The Ainsley-Oakes Square Hole Drilling Machine.* Description with inset of working drawings of this ingenious machine. *Eng. News*, June 20, 1891, p. 579.

**Drills, Diamond.** Shows results obtained by the use of the diamond drill. *Van Nos. Eng. Mag.*, Vol. IX., p. 438.

*Githens.* An illustrated description of a direct acting percussion drill. Its distinguishing features are the valve motion, rotation, front head and feed screw connection. *Eng. News*, March 26, 1887.

*Trials of Rock Drills.* A paper by Mr. E. H. Carbutt and Mr. Henry Davy, read before the Inst. of Mech. Engrs., giving the results of some recent trials, and describing the mechanism of each drill, seven power drills and two hand drills were tested, all being of the percussive kind. *Iron*, Apr. 31, 1891, pp. 289-93.

**Drills, Twist.** An inquiry into the requirements of the cutting edges of twist drills. A paper before the Am. Soc. Mech. Engrs. by Wm. H. Thorne. *Am. Eng.*, Nov. 19, 1885.

See *Mining Machinery*.

**Drop Press, Pressure Attainable by the Use of the.** By Prof. K. H. Thurston. Obtained an efficiency of 90%. Gives table of pressures obtained by using drops weighing from 50 pounds to 2,000 pounds, falling from 3 inches to 5 feet. *Van Nos. Eng. Mag.*, Jan. 1884.

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**Dye Works.** See *Ventilation of*.

**Dynagraph, Dudley's.** Illustrated description of an instrument invented by P. H. Dudley for making a complete record of power exerted by a locomotive. *Eng. News*, May 15, 1891, pp. 167-69.

**Dynamics.** See *Parallel Motions*.

**Dynamometers.** A description of several styles, with the principles on which they act. By C. F. White. *Four. Assn. Eng. Soc.*, Vol. IV., p. 333. See also *Indicators*.

A continuous registering belt dynamometer, wherein the friction of the apparatus is eliminated. Described and illustrated in *Sci. Am. Sup.*, December 4, 1886.

**Atchison, Topeka & Santa Fe Railway.** This simple form consists essentially of a heavy locomotive spring, whose deflection under the pull of the engine is indicated on the dial. Full drawing. *Ry. Rev.*, Jan. 1891, pp. 8-9.

**Construction of a Large Prony Brake.** By R. H. Thurston. Specifically described and worked out. *Four. Frank. Inst.*, April, 1886.

**French Transmission.** Gives a description of a dynamometer constructed and used to determine the efficiency of a plant for the transmission of power by electricity. *Lon. Engineer*, Feb. 17, 1888.

**Friction Brake.** By W. W. Beaumont. A paper and discussion covering 77 pages, and covering the whole ground of appliances, principles and practice. Illustrated. *Proc. Inst. C. E.*, Vol. XCV.

**Friction of a Transmitting Dynamometer.** Abstract of paper by Samuel Webber, Charlestown, N. H., describing tests on the friction of a Webber transmitting dynamometer at different loads and speeds. *Mechanics*, June, 1889.

**The Tatham.** Used for testing motors at the Phil. Elec. Ex., capacity 100 H. P. Tested by churning water and getting thus the mechanical equivalent for 1° Fahr., which was found to be 772.8 ft.-pds. thus proving its absolute accuracy within exceedingly small limits. Illustrated. *Four. Frank. Inst.*, Dec., 1885.

**Testing the Force of the Hammer Blow of Locomotive Drivers.** Designed by a joint committee from the Master Mech. Assn. and the Franklin Inst. Described and illustrated. *Ry. Rev.*, Oct. 9, 1886.

**Wallace's Graphic Dynamometer.** Brief description of a dynamometer for measuring amount of power consumed by any machine or part of any machine while in motion. *Ind. Eng.*, Jan. 11, 1890, p. 30.

See *Engines, Steam. Indicators*.

**Dynamometer Car, Western Railway of France.** Description of an car designed to make the following researches: (1) Measurement and registration of tractive efforts; (2) registration of total work done; (3) registration of speed; (4) registration of number of revolutions of wheels; (5) registration of time at ten-second intervals; (6) marking kilometres run and other points of interest; and (7) the analysis of the products of combustion from locomotive. Illustrated. *Ry. Rev.*, Oct. 26, 1889, Vol. XXIX., p. 627.

**Dynamometric Brake, Brauer's.** Described and illustrated in *Proc. Inst. C. E.*, Vol. LXXX., p. 266.

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**Dynamos.** See *Armatures. Electric Dynamos*.

**Eads, James B.** An exhaustive biography, with portrait. *Sci. Am. Sup.*, May 7, 1887.

A short sketch of his life and achievements. *R. R. & Eng. Jour.*, April, 1887.

Eulogy by E. L. Corthell. *Jour. Assn. Eng. Soc.*, September, 1890, pp. 456-61.

*With Portrait.* *Mechanics*, April, 1887; *R. R. Gaz.*, March 18, 1887.

**Earth, The Figure of.** By Frank C. Roberts, C. E. An historical and mathematical paper, showing the various ways in which the spheroidal form is determined. *Van Nos. Eng. Mag.*, March, 1885.

**Earth Pressure.** By Wm. Cain. Gives a comparison between results obtained from a formula and from experiments. *Van Nos. Eng. Mag.*, Vol. XXVI., p. 89.

*Actual Pressure of.* By Benj. Baker. A paper of great value to all who are likely to be confronted with the question of high retaining walls. *Van Nos. Eng. Mag.*, Vol. XXV., pp. 333-353 and 492; also No. 56, *Van Nos. Science Series*.

*New Investigation on Earth Pressure*, and the most economical shape of retaining walls. By M. L. Leygoe. This very interesting paper contains the results of an extended series of experiments on the cohesion of earth, the direction, point of application, and amount of earth pressure, and the best form of retaining wall, with empirical formulas deduced therefrom, and all compared with results given by ordinary theories and with other experiments. *Annales des P. & C.*, November, 1885, pp. 788, 1004.

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*Charleston. Origin of, The.* By Emil Starek. Treated with equations to determine point of origin. Illustrated with a map. *Sch. Mines Quar.*, October, 1886.

*Grenada in 1884.* A description which is of interest in view of the recent earthquake at Charleston. *Trans. Inst. C. E.*, Vol. LXXXV. p. 275.

*Spanish.* By C. G. Rockwood, Jr. With sketch map and views. Also, four other papers on the same subject. *Science*, March 6, 1885.

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*Their Effect* on the alignment of railroads in the South. Described and photographic cut shown. *R. R. Gaz.*, Oct. 29, 1886,

1886. Their influence on light-houses. *An. Rpt. Light-House Board*, 1886.

See *Canals, Ship, Nicaragua*.

**Earthwork.** A paper by George J. Specht, before the Tech. Soc. of the Pac. Coast. Treats of hull construction, and also the results of the extended investigation of the relative volumes in cut and fill. Also gives the German method of computing haul, with a full page diagram. A valuable paper. Reprinted in *Eng. News*, Aug. 22, 1885.

*Borrow-Pit Excavation at Portland, Oregon*, for N. Pac. R. R. terminal yards. The earth loosened on bluff banks by Judson powder, and wheeled to cars on elevated platforms. Proved more economical than steam shovels. *Illus. Eng. News*, Nov. 28, 1885.

*Calculation of.* By N. B. Putnam. Discusses Simpson's rule and the prismoidal formula. *Von Nos. Eng. Mag.*, Vol. XVI., p. 161.



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*Center of Gravity of*. By J. W. Davis. Proposes a method for simplifying the computation of haul, etc. *Van Nos. Eng. Mag.*, Vol. XVII., p. 83.

*Consolidation of treacherous slopes* in heavy cuts by means of rubble spurs perpendicular to face of slopes. *Annales des P. & C.* 1888, p. 5; Abstract in *Proc. Inst. C. E.*, Vol. XCV., p. 465.

*Computation by Diagrams*. Gives some diagrams illustrating practically the method used in Mr. Wellington's treatise. *Eng. News*, Sept. 3, 1887.

*Computation of*. By E. W. Hyde. Investigates the application of the prismoidal formula and compares it with Weddle's formula. *Van Nos. Eng. Mag.*, Vol. XV., p. 227.

*Computations. The legal status of the "end-area" earthwork computations*. An editorial article of value in *Eng. News*, Nov. 9, 1889, Vol. XXII., p. 445.

*Estimating*. By J. R. Gillis. Gives method of estimating the work from profile when lack of time prevents more accurate methods. *Van Nos. Eng. Mag.*, Vol. II., p. 532. *Trans. A. S. C. E.*, 1869.

*Estimating Overhaul in Earthwork by Means of the Profile of Quantities*. This method is described and an example given by S. B. Fisher. *Eng. News*, Jan. 31, 1891, pp. 98-9.

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*Graphical Estimates for Railways*. Gives method consisting essentially of three diagrams, viz.: for section-areas of through-cut sections, for areas of hill-side sections, and for a correction to be applied to end-area solidities. *Van Nos. Eng. Mag.*, Vol. VI., p. 84.

*Graphic method for measuring cross-sections*. By M. H. Willette. Gives simple method of constructing profile of cross-section and obtaining its area. *Van Nos. Eng. Mag.*, Vol. XXIV., p. 153.

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*Profile of Quantities*. From the German. Illustrated. A graphical method of determining grade line and haul for given relations of cut and fill. *Am. Eng.*, Oct. 1, 1885.

*Shrinkage of*. By P. J. Flynn, before the Tech. Soc. Pac. Coast. A very valuable paper, giving a summary of all published rules and experiments on the subject. Attention called to the error made in allowing, in embankments, a correction only for ultimate shrinkage from cut to fill, without reference to first increase in embankment. *Van Nos. Eng. Mag.*, Dec., 1885. *Eng. News*, May 1 and 8, 1886.

*Specifications*. Suggested improvements and changes in the ordinary methods of classifying materials in excavations by a "Contractor." *Eng. News*, April 5, 1890, Vol. XXIII., p. 329.

*Tables*. By W. B. Ross. Describes some simple tables that are universal in their application. *Van Nos. Eng. Mag.*, Vol. V., p. 594.

*Tables for finding end areas* for three-level sections. A description of the tables

**Earthwork, continued.**

used by W. W. Redfield, whereby the labor is greatly reduced. *Four. Assn. Eng. Soc.*, Vol. V., p. 217.

*Theory of Calculating Slopes.* By Prof. Merriman. Wherein the cohesion of the material is taken into account. *Eng. News*, March 14, 1885, *et seq.*

See *Excavation, Railroad Construction. Railroad Earthwork.*

**Economy of Structures, Comparison of the.** By Prof. G. F. Swain, before the New England Water-Works Association. Discusses the proper method of comparing the economy of structures of different classes. *Four. N. E. W.-Works Assoc.*, March, 1888, Vol. II., pp. 31-34.

*Comparative*, or other engineering and architectural works. By Arthur Cobb. The subject investigated by means of algebraic equations, all the functions entering in with their proper values. An interesting and valuable discussion. *Van Nos. Eng. Mag.*, December, 1886.

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An address by Robert H. Thurston, delivered at the seventeenth annual commencement of the Worcester Polytechnic Institute on technical training, considered as a part of complete and generous education. *Sci. Am. Sup.*, July 16, 1887.

Report of the Commissioner of the Society of German Engineers in regard to the preparatory schools for higher scientific training. Discussion of the "Gymnasien" and "Realschulen." Published with *Zeitsch d. V. Deutscher Ing.*, No. 16, 1886.

*Of the Mechanical Engineer.* A paper by C. H. Benjamin, read before the Civil Engr. Club of Cleveland, giving a comprehensive and practical discussion of the subject. *Four. Assn. Eng. Soc.*, July, 1891, pp. 344-53.

*Technical, on the Baltimore & Ohio R. R.* A long extract from the principle of the B. & O. school, with long comments on the same. *R. R. Gaz.*, April 22, 1887.

See *Technical Education.*

**Effects of Heat and Cold on Metals.**

See *Heat and Cold.*

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*Steam.* By W. L. Clements before American Society of Mechanical Engineers. Describes the general construction of steam excavators, and then gives details of a special machine. Abstracted, *R. R. Gaz.*, May 11, 1888; also *Eng. News*, May 26 et seq., 1888, and supplemented by information from other sources.

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**Expansion of Metals.** See *Metals*.

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*For a Car Ferry on the Mississippi River at St. Louis.* By Robt. Moore. The general problem discussed, with full drawings of the device used. *Trans. A. S. C. E.*, Vol. XIII., p. 247.

*For Railway Transports.* The Isle of Wight Steam Ferry. A landing moving on inclined ways connects with steamer at different stages of tide. Illustrated. *Lon. Eng.*, Aug. 7, 1885. See *Floating Landings*.

See *Landing*.

**Fiber.** *Lime Sulphite Fiber Manufacture in the United States.* Paper by Maj. O. E. Michaelis, M. Am. Soc. C. E., and also Remarks on the Chemistry of the Process. By Martin L. Griffin, M. A., p. 23, *Trans. A. S. C. E.*, June, 1889, Vol. XX., p. 263.

**Filters.**

*Analysis of Mechanical Action of Filters.* A paper by Mr. Emil Geyelin. This paper discusses nearly all the more prominent filters in use and made for use of water works, and forms a valuable source of information. *Am. W.-W. Assn.*, Louisville meeting, 1889, p. 67.

**Filters, continued.**

*Breyvis' Micromembran Filter.* A short description of this filter, in which ground asbestos is used as filtering material, and which it is claimed will prevent the passage of bacteria. *Journ f. Gasbel, u. Wasservers,* 1886, pp. 412-416. Describes a number of small filters used in different places. *Van Nos. Eng. Mag.*, Vol. XXIII., p. 152.

*Piefke's Filter.* Adapted for use on large or small scale. Filtering material is a specially prepared form of asbestos and other fibres. Short description without data regarding cost, etc. *Journal f. Gasbel, u. Wasservers,* 1886, pp. 781-788.

*Warren.* Description of the Warren water filter, with plan and sections. *Eng. News*, Nov. 19, 1887.

See *Water Filtration and Purification.*

**Filtration.**

*Data of.* Papers by Prof. Wm. T. Sedgwick in *Tech. Quart.* No. I, "Some Recent Experiments on the Removal of Bacteria from Drinking Water by Continuous Filtration through Sand," giving the results. Discussion of the experiments in Berlin. Vol. III., 1890, No. 1, pp. 69-75. No II., "On Crenothrix Kuehnianas (Rabenhorst), Zopf," giving an account of several cases of occurrence and its effect on the water. Vol. III., 1890, No. 4, pp. 338-65.

*Experiments on.* By Dr. Plagge. Report to the German Soc. of Naturalists. Experiments on filtration of germs or bacteria. Bischoff's spongy iron filter and all the charcoal filters were entirely unable to remove germs, filtered water often containing more than the unfiltered. The same was true of some paper and cellular filters. The Chamberland clay filter and that of Dr. Hesse were found to filter germs entirely at first, though after a time they were not effectual. Some asbestos filters (Breyvis' "micromembran filter") filtered perfectly at first, but allowed germs to pass in a short time. *Journal f. Gasbel, u. Wasservers,* 1886, pp. 809-812.

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*Of Natural Waters.* A paper by Mr. T. M. Drown, read in Boston, Jan. 15, 1890. *Four. Assn. Eng. Soc.*, July, 1890, pp. 356-68. *Eng. & Build. Rec.*, Nov. 22, 1890, p. 394-6.

*Practical Results of Mechanical.* By W. S. Richards. A paper before the American Water-Works' Association, giving experience with Hyatt filters at the Atlanta water-works. *Proc. Am. W.-W. Assn.*, 1888, pp. 148-152. Abstracted *Eng. & Build. Rec.*, May, 1888.

*Of Public Water Supply.* Account of extensive experiments by the East London Water Company with the Atkins filter. Illustrated. *Iron*, Nov. 6, 1885.

*Rate of Through Sand,* in terms of the head and the average size of the grains of sand. A formula from the German. *Eng. News*, Oct. 24, 1885.

*Or Subsidence.* Abstract from a paper by J. D. Cook, before the American Water-Works Association. Treats of the most practicable and economical method of obtaining a supply of clear water from streams carrying considerable quantities of silt. *San Eng.*, July 30, 1887.

See *Sewage Disposal, Water Purification, Water Supply.*

**Fire Apparatus.**

*Modern Fire Apparatus.* A popular article by John R. Spears. Illus. *Scribner's Magazine*, Jan., 1891, pp. 54-64.

**Fire Apparatus, continued.**

*About Shops and Buildings.* A valuable paper by Mr. C. J. H. Woodbury before Am. Soc. of Mechanical Engineers. *Ry. Rev.*, Dec. 4, 1889. Vol. XXXI., p. 718.; *Eng. News*, Dec. 14, 1889, Vol. XXII., p. 568.

**Fire Bricks.**

*As Manufactured at Mt. Savage, Md.* A paper before the Am. Inst. Min. Eng. at Pittsburg meeting, Feb., 1886, by Robert Anderson Cook. This is probably the best known manufactory of fire-brick in America. *Eng. News*, April 10, 1886; also *E. & M. Jour.*, March 13, 1886.

By Lieut. G. E. Glover. Extracts from a paper presented to Corps of Royal Engineers. *Van Nos. Eng. Mag.*, Vol. VI., p. 6.

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A description of such devices as are used to prevent the spread of fires in mines. By Chas. M. Rolker. *Eng. News*, May 2, 1885.

**Fire-Damp in Coal Mines.** Apparatus for indicating at the surface the exact amount of it in any part of the mine without having to visit the region personally. A very ingenious and apparently practicable invention. Fully illustrated. *Sci. Am. Sup.*, Feb. 13, 1885. Caused by falling barometer.

See *Coal Mine Explosions*.

**Fire Grates.** *Donnelley for Boilers.* Gives plan, elevation and section of the Donnelley fire grate and the results of experiments with different kinds of coal. *R. R. Gaz.*, Jan. 6, 1888.

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*From Electricity.* A lecture by C. J. H. Woodbury before the students of Sibley College. *Sci. Am. Sup.*, No. 830, Nov. 28, 1891, pp. 1367-9. *Elec. Eng.*, Nov. 18 and 25, 1891.

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**Fire Streams.** *Hydraulics of Fire Streams.* A valuable paper by Mr. John R. Freeman, M. Am. Soc. C. E., with discussion by Clemens Herschel, Mansfield Merriman, E. Kuichling, Geo. F. Swain, J. P. Church, E. B. Weston, R. Her- ing and John R. Freeman. Fully illustrated by plates and diagrams. *Trans. A. S. C. E.*, Nov., 1889, Vol. XXI., pp. 303 *et seq.*

**Fires.** Abstract of. *Eng. & Build. Rec.*, Sept. 7, 1889, Vol. XX., p. 201, *et seq.*

*Effect of fire and sudden cooling* on columns of cast iron, wrought iron and stone. An abstract of the experiments of Prof. Bauschinger on this subject (as detailed in the 12th Heft of his "Mittheilungen") is given in the *Deutsche Bauzeitung*, 1885, pp. 343-346.

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**Hydrant.** The Greathead Injector Hydrant for Fire Extinction. Two systems of pipes, one for service, the other small, with water at very high pressure

**Fires, Hydrant, continued.**

given to it by hydraulic accumulator. A connection established between these two systems at a hydrant working on the principle of the steam injector draws most of the water from the large service pipes with a very much higher pressure. Cut given. *Eng. News*, Feb. 20, 1886.

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**Prevention of.** See *Sprinklers*.

**Prevention and Extinction of.** A paper by A. Chatterton, describing methods of fire-proofing buildings and means of quenching fires. *Proc. Ins. C. E.*, Vol. XCIII., p. 437.

**Protection of Mills, from.** By C. J. H. Woodbury. A very complete paper of 35 pages, with many cuts, giving the appliances used and organization of the fire brigade as in vogue in the New England Mills. *Trans. A. S. M. E.*, Vol. II., p. 301.

**Firearms. Development of Automatic.** Gives a two-page plate and short description of the details of the Maxim gun. *Lon. Eng.*, Jan. 27, 1888.

**Fireproof Arches. Tests of.** Full account of tests made on three kinds of fire-proof arching at Denver, Colo. Tests for strength under static load, resistance to fire and water and to continuous fire, were conducted, and the results are given in full. Illustrated. *Am. Arch.*, No. 796, March 28, 1891, pp. 195-201.

**Fire-Proof Buildings.** A letter from Mr. Edward Atkinson in *Am. Arch.* containing many valuable suggestions concerning fire-proof and slow-burning business buildings. *Am. Arch.*, Dec. 21, 1889, p. 293.

**Fire-Proof Construction.**

**At Moderate Cost.** By C. T. Aubin. Precautions that should be observed. Appliances to put out fires, etc. *Jour. Assn. Eng. Soc.*, Vol. IV., p. 158.

A series of articles of value, by F. Collingwood, Mem. A. S. C. E., and M. Inst. C. E., in *San. Eng.*, (New York), Feb. 11, *et seq.*

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By Theo. Rosenberg. Some practical suggestions of value. *Jour. Assn. Eng. Soc.*, Vol. V., p. 121.

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**Fire Proof Construction.** See *Beton. Building Construction*.

**Fireproof Materials, Tests of, at Boston.** Walls and sides of buildings treated with various materials were subjected to great heat. Details described and illus. *Eng. News*, Oct. 31, 1891, pp. 417-18. Abstract from official report giving conclusions, *ibid.*, Nov. 14, 1891, p. 462. Full report in *Am. Arch.*, Nov. 14, 1891, pp. 101-2. *Abs. Science*, Nov. 13, 1891. *Eng. Record*, Oct. 24, 1891.

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**Their Defects.** An illustrated editorial of four columns, showing that fish-plates fail more from the bending moment on them than from shear, and suggesting that a form be used to resist shear only. *R. R. Gaz.*, Sept. 3, 1886.

**Some Tests of Iron Fish-Plates at a Freezing Temperature.** A paper by David Buel read before the Wisconsin Polytechnic Society, giving results of several tests. *Eng. Record*, July 4, 1891, p. 70.

**Flexure, Resistance of Beams to.** By J. G. Barnard. An abstract from a paper on the resistance of materials, by M. Decamble, with comments. *Trans. A. S. C. E.*, Vol. III., pp. 123-128.

**Floating Deflectors.** See *Harbor Improvement*.

**Floating Landings.** A description of such landings designed for passenger traffic. From the Dutch. Illustrated. *Eng. News*, Aug. 8, 1885.

**Flood Announcements.**

Treatise on, and on the Hydrology of the River Seine. [Manuel Hydrologique du Bassin de la Seine. De Preaudeau, 1884.] Reviewed in *Annales des P. & C.*, 1884-2-610. For several years the heights and times of maximum flood heights along the Seine at Paris, and at Points below, have been publicly announced several days in advance, to the great advantage and benefit of all interested inhabitants. The book in question shows how this result has been accomplished. The review gives suggestions as to still further improving this "hydrological service."

Valley of the Ohio. Plan for same. *Annales des P. & C.*, November, 1884.

**Flood Discharge from Catchment Areas.** A theoretical formula with empirical coefficients with special reference to India. *Proc. Inst. C. E.*, Vol. LXXX., p. 201.

**Flood Gates, Automatic.** Gives brief description, with cuts, of the Czvetkovics automatic flood gate. *Lon. Eng.*, July 13, 1888.

**Flood Heights in Rivers as Affected by the Change from Wild to Cultivated Conditions.** By Gustav v. Wex. Translations of two pamphlets on the subject, using European data. Issued by the Engr. Dept., U. S. A.

*As Affected by the Destruction of Forests.* By Thos. P. Roberts, with discussion and plates. A large mass of data, with important discussions. *Trans. Eng. Soc. West. Penn.*, Pittsburg, 1884.

**Mississippi River.** See *River Improvements*.

**Flood Rock Removal.**

A carefully written account of the entire work, by Lt. Geo. M. Derby, who has been officially connected with the work. An historical and descriptive account of permanent value. Illustrated. *San. Eng.*, Dec. 3, 1885.

See *Harbor Improvements, Hell Gate*.

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*The Flood of June, 1880, in the West Branch of the Susquehanna River.* Abstract of the report of Maj. Chas. W. Raymond. U. S. Engrs., giving the main facts of the flood, reviewing the causes and giving several possible methods of protection from floods. *Eng. News*, Feb. 14, 1891, pp. 152-3.

Great Floods on the Lower Miss. Riv., as illustrated in the flood of 1882. By J. B. Johnson. Accompanied by map of the valley showing overflow area below Cairo. *Jour. Assn. Eng. Soc.*, Vol. II., p. 115.

*Inefficiency of Reservoir to Prevent Inundation.* An article by Mr. Gros, in *Annales des P. & C.*, II., 1890, giving as the result of several years study of some large rivers of France, the conclusion that floods cannot be appreciably diminished by this means. *Eng. News*, March 14, 1891, pp. 258-9.

*Mississippi Flood of 1890.* A discussion of this flood and the effect of levees on same; mainly by Mr. B. M. Harrod. The conclusion is that the levees have been beneficial. *Eng. News*, April 5, 1890. Vol. XXII., p. 315.

*Prediction of Floods in the Central Loire.* Account of methods employed, with discussion of various formulas and diagrams. *Annales des P. & C.*, Oct. 1890, p. 441. *Proc. Inst. C. E.*, Vol. CIII., 1891. Foreign abstracts, pp. 425-6.

*Prediction of High Water on the Elbe in Bohemia.* The discharge of the various tributaries is measured. Account of method with curves of discharge given. By — Holtz. *Annales des P. & C.*, April, 1891, pp. 477-84.



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*In Stony Brook, Prevention of .* A report of 29 pp. by a Commission, consisting of Jas. B. Francis, Eliot C. Clarke and Clemens Herschel, to the Mayor of Boston, accompanied by a map and six plates. The report is of value to engineers generally, as bearing on the question of the maximum instantaneous discharge from a given valley. Persons designing sewers, culverts, and water-ways under bridges would do well to consult it. *Boston City Document* 159, 1886.

See *Johnstown Disaster*.

**Floor Construction.**

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Abstract of a method used in "*Centralblatt der Bauverwaltung*." Iron girders are used as usual with "plaster beams" as filling. *Eng. News*, April 12, 1890, Vol. XXIII., p. 341.

*Fireproof.* Designs and estimates for a proposed combination of cement and iron, by F. H. Kindl. *Eng. News*, July 4, 1891, pp. 2-3. Illustrations of a similar construction, *id.*, July 25, 1891, p. 81.

**Floor Construction.** See *Building Construction. Fire Proof Arches*.

**Flooring, Steel.** Gives description, with illustrations showing the application of Lindsay steel flooring. *Lon. Engineer*, Oct. 7, 1887; *Eng. News*, Nov. 26, 1887.

**Floors.**

*Brick and Cement.* Details of a number of experiments made to determine the strength of the different systems of brick and cement floors. *Van Nos. Eng. Mag.*, Vol. III., p. 45.

*Experiments Upon the Resistance to Shock of Beton Floors and Arches in Brick Masonry.* Illustrated description of several experiments on floors. *Eng. News*, July 12, 1884, p. 13.

*In Mills.* By C. J. H. Woodbury. Loads, formulas for designing, and practical details of construction. Illustrated. *Trans. A. S. M. E.*, Vol. II., p. 468.

*Weights of.* See *Building Construction*.

See *Lime Floors*.

**Flour-Mill Analysis.** A full account of some flour-mill tests to determine the power used, and where it was spent. Apparently a profitable kind of investigation for any mill. *Am. Eng.*, Dec. 3, 1883.

**Flour Milling.** *Modern Flour Milling*, A paper by J. Harrison Carter, describing the various details of flour manufacture, and machinery used, with discussion. *Four. Soc. Arts*, March 6, 1891, pp. 299-313.

**Flour Mills and their Machinery.** A historical and descriptive article. Illustrated. *Proc. Inst. C. E.*, Vol. XC., p. 366.

See *Milling*.

**Flow of Air,**

*And Other Gases.* Experiments and formulæ especially adapted to blast-furnaces. By F. W. Gordon. *Trans. A. I. M. E.*, Chattanooga meeting, 1885.

*In Sewers.* See *Sewers*.

**Flow of Metals in the Drawing Processes used in the Arts.** A lecture by Oberlin Smith. Describes tube and wire drawing, stamping, etc. Illustrated. *Four. Frank. Inst.*, Nov., 1886.

**Flow of Solids.** See *Forging*.

**Flow of Water.** See *Ditches. Hydraulics, Flow of Water*.

**Flues**, *Experimental Investigations of the resistance of, to collapse*. By C. R. Roecker. Details the experiments made of flues and discusses the formulæ derived from the experiments by various writers. *Van Nos. Eng. Mag.*, Vol. XXIV, p. 208.

**Fluid Friction**. *Experiments on Rotation of Disks in Fluids*. By Prof. W. C. Unwin. *Proc. Inst. C. E.*, Vol. LXXX., p. 221.

**Fluids**, *Resistance of*. Abstract from "Sonnell's Dictionnaire des Mathematiques, Appliquees." *Van Nos. Eng. Mag.*, Vol. IV., p. 431.

**Flushing**. See *Siphon*.

**Flushing Tanks**,

*Automatic*, for urinals and water-closets. Causing a saving of 80 per cent. of water used, as compared with a small continuous stream. *Abstracts of Papers, Inst. C. E.*, 1885.

*The Rosewater Flush*. A description of an automatic flush-tank now in use on the Omaha Sewage Works. *Eng. News*, July 17, 1886.

**Flushing Tunnel**, *The Milwaukee*. A full illustrated description of the tunnel from Lake Michigan to the Milwaukee river, built for flushing the river from sewage contamination. Water is forced through the tunnel from the lake by a wheel operated by a 350 H. P. engine. *Eng. & Build. Rec.*, Dec. 8, 1888.

**Fly Wheels**. See *Engines, Steam, Fly Wheels*.

**Forced Draught**. See *Boilers, Forced Draught for*.

**Forces**. On the mutual forces acting between masses of matter, with application to mechanical, physical and chemical phenomena. By M. P. Berthot. Considers molecular forces as well as forces acting at finite distances, application to liquids and gases, capillarity, chemical phenomena, etc. *Mem. de la Soc. des Ing. Civils*, Nov. 1885, pp. 580-626.

**Forests**. *Their Influence on Rainfall*. A paper by Prof. Geo. F. Swain, giving an able and rational discussion of the subject, and including a synopsis of the known facts relating thereto. *Four. New. Eng. W-W. Assn.*, Vol. I, No. 3.

**Forging**. *Hydraulic Forging and the Flow of Solids*. Notes suggested by alleged defects in certain forgings made by pressure. A paper by Coleman Sellers, E. D., Professor Engineering Practice at Stevens Institute of Technology. *R. R. Gaz.*, Feb. 7, 1890, Vol. XXII., p. 86, *et seq.*

**Forging Machines**.

*Hydraulic Forging Machines and Steam Hammers*. Reprint of paper by Prof. Coleman Sellers before senior class at Mass. Inst. Tech. From *Stevens Indicator*. *R. R. Gaz.*, Aug. 2, 1889.

*Press of 4,000 tons capacity*. A description, with many cuts, of this hydraulic press now building at Sheffield, Eng. *Lon. Eng.*, April 23, 1886.

**Forging Machines**. See *Hammers. Screw Forging Machines. Steam Hammers*.

**Forts**. *Protection of Heavy Guns for Coast Defense*. Extracts from an article by Capt. G. S. Clarke, R. E., taken from the *Proceedings of the Royal Artillery Institution*, Woolwich, Febr. 1887. *Proc. of the U. S. Naval Inst.* for 1887, Vol. XIII., No. 2.

**Foundations**

Lecture delivered by Francis Collingwood, before the students of the Rensselaer Polytechnic Institute. The specific subjects discussed are: examination of the soil, compressibility of masonry, bearing power of various soils and problems connected with building upon them, bearing power of piles, and the various methods of founding under water. Many examples from actual practice are given, also references to the literature bearing on the subject. *The Polytechnic*, Jan. 24, 1891, pp. 92-100. Reprinted in *Eng. News*, Feb. 14, 1891, pp. 161-2, *et seq.* *Eng. Record*, Feb. 21, 1891, pp. 198-9, *et seq.*

By W. C. Street. Treats of foundations in peat, sand and clay soils. *Van Nos. Eng. Mag.*, Vol. XXVI., p. 337.

## Foundations, continued.

*Bartholdi Statue.* Elevations and sections. *Sci. Am.*, June 13, 1885.

*Bartholdi Statue.* See *Bartholdi Statue*.

*Bridge.*

*And Piers of the W. & L. E. Railroad Bridge at Toledo.* By Chas. E. Greene. *Report Mich. Assoc. Surv.*, 1882.

*Brooklyn Anchorage of the East River Bridge.* By F. Collingwood. Gives details of method of construction adopted. *Trans. A. S. C. E.*, Vol. III., pp. 142-146.

*Empress Bridge over the Sutlej, India.* The piers are of stone, resting on metallic tubes, three to each pier, which extend to a depth of 100 feet below low water. From the French. Illustrated. *Sci. Am. Sup.* Aug. 8, 1885.

*Forth Bridge.* The Great Caissons; Their structure, building and founding. By H. S. Biggart, before the Inst. of Engrs. and Shipbuilders, Scotland. *Lon. Eng.*, Nov. 27, 1885, *et seq.* See also *Caissons* below.

*Hawkesbury Bridge.* *Recent Progress in Sinking Deep Foundations for Engineering Works.* By Charles Ormsbee, Engineer in charge of Hawkesbury Bridge. From *Proc. of Australian Soc. for the Advancement of Science.* *Eng. News*, Feb. 1, 1889, Vol. XXIII, p. 114.

*Hawkesbury River Bridge.* Detailed drawing of the plan proposed by the Union Bridge Co. *R. R. Gaz.*, June 18, 1886.

*New London, Conn., R. R. Bridge.* A combination of crib, piles and open caisson. A. P. Boller, Engineer. Description, with illustration of bridge, in *Sci. Am.*, June 8, 1889.

*New Tay Bridge.* Description and cuts showing the work in progress, from the French, in *Sci. Am.*, Jan. 9, 1886.

*New Tay Bridge.* Illustrated and described by C. Barlow before the British Assoc. *R. R. Gaz.*, Dec. 4, 1885.

*New Tay Bridge.* *Sinking of the Cylinders by Pontoons.* By Andrew S. Biggart. A paper before the Inst. of Engrs. and Shipbuilders, Scotland. Illustrated. *Lon. Engineer*, July 10, 1885; also *Eng. News*, Aug. 1, 1885; also *Lon. Eng.*, June 26, 1885.

*Schuylkill B. & O. Bridge at Philadelphia.* Description of caisson, crib, and cofferdam used on the pivot pier. Sooy Smith & Co., contractors; Wm. M. Patton, engineer in charge. Well illustrated. *Eng. News*, March 27, 1886. Also by A. Brooks Cuthbert. A series of articles in *Eng. Era*, Dec. 31, 1885, *et seq.* Illustrated.

*Texas River R. R. Bridge, Ala.* The Cushing system of piles inside iron cylinders was used. Fully illustrated and described by Col. Wm. M. Patton, in *Eng. News* of June 20, 1885.

See *Pile*, below. Also *Bridge Foundations*.

*Caissons.* *Cribs and Cofferdams* used on the foundations of the new Havre de Grace bridge on the B. & O. Ry. By Col. Wm. M. Patton, engineer in charge. This work is under contract by Gen. Sooy Smith & Son, and the rate of progress made has been remarkable. Plans, elevations and sections given of the caissons. First article in *Eng. News* of Feb. 7, 1885.

*Forth Bridge.* A full-page cut in perspective; also sectional illustrations. *Lon. Engineer*, Feb. 6, 1885; also *Lon. Eng.*, same date.

*With lateral opening against a rough masonry wall.* Description of how the joint was made by means of tarpaulin, to be readily set and removed. *Lon. Eng.*, June 12, 1885; also *Iron Age*, July 2, 1885.

*Cofferdams and Floating Caissons.* A paper by Randall Hunt, read before the Tech. Soc. Pacific Coast. Several actual examples are given and illustrated. *Ry. Rev.*, Jan. 3, 1891, pp. 3-5.

## Foundations, continued.

*Coffer Dams.* See *Coffer Dam*.

*Concrete.* By J. E. Blackwell. Gives specifications for and cost of concrete foundations; also the relative strength of different cements. *Sci. Am. Sup.*, Oct. 8, 1883.

*Concrete, Brickwork and Stonework.* A description of an attempt to render concrete, brick and stone more easily available for cylindrical foundations. *Van Nos. Eng. Mag.*, Vol. VIII., p. 335.

*Cooper Institute.* Why they failed and how the faults have been remedied. An excellent example of very common faults in buildings. Fully described and illustrated by 14 cuts in *San. Eng.*, New York, Nov. 5, 1885.

*Deep.* By Col. Wm. M. Patton, C. E. Discusses timber piles, open caissons, pneumatic process, suspension of caissons while sinking, and concrete. *Eng. News*, July 18, 1885.

*For Drop Presses.* Illustrated account of manner of constructing the foundations for a drop forging plant for the Gorham Manufacturing Co. at Providence, R. I. *Eng. News*, Feb. 22, 1890, Vol. XXIII., p. 186.

*Elastic, for Dynamos, Steam Engines, etc.* Describes and illustrates a method of preventing the vibration of such machinery being communicated to the ground and buildings. *Elec. World*, Jan. 5, 1889.

*For Engines.* See *Asphalt*.

*Equalizing Pressure on.* By J. H. Apjohn, M.I.C.E. With especial reference to foundations in the alluvial soil of Bengal. *Ind. Eng.*, January 5, 1889, *et seq.*

*And Floors for the World's Fair Buildings.* Abstract of a paper by A. Gottlieb before the West. Soc. Engrs., describing methods of determining supporting power loads adopted, and plan of construction. *Eng. Record*, December 5, 1891, pp. 15-16.

*Of Garfield Monument.* A paper by James Ritchie and a lengthy discussion. *Four. Assn. Eng. Soc.*, Vol. V., p. 410.

*Of a Heavy Fireproof Building on Compressible Soil.* An account of the methods and results used for such a building in Chicago, by W. L. B. Jenney. *San. Eng.*, Dec. 10, 1885. *San. News*, Chicago, Jan. 2, 1886.

*For Heavy Buildings.* A short article in the London *Architect*, discussing the best manner of distributing the weight upon the foundations. *Eng. Record*, Jan. 31, 1891, pp. 140-2.

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**Fuel, Oil for Fuel, continued.**

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See *Public Works*.

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## 200 GOVERNMENT SCIENTIFIC WORK—GUN FACTORIES.

### Government Scientific Work, continued.

of the Senate and House during the last session of Congress. Also, about 70 pp. of descriptions of the geographical, topographical and geological surveys of other countries. Apply to Maj. Powell, Washington. On the same subject See an 8-page synopsis in *Science*, April 17, 1885; also review above report. *Science*, April 24, 1885.

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**Heating, Steam, etc., continued.**

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**Hydraulics, Flow of Water, Over Weirs, continued.**

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See *Hydraulics*.

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**Hydraulics, Flow of Water, Formulae for, continued.**

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**Ice Houses.**

See *Railroad Structures*.

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**For Streets of High Grades.** *An. Rep. Board of Public Works, Duluth, Minn., for the Year ending Feb. 28, 1890*, pp. 87-93 and plates.

**Bricks.** See *Bricks.*

**Materials. Test of.** Record of absorption and abrasion tests made on several specimens of brick and granite. By J. Herbert Shedd, City Engr., Providence, R. I. *Eng. Record*, Sept. 26, 1891, pp. 166. *Eng. News*, Sept. 26, 1891, p. 295.

**Stones.** Apparatus used by French Engrs. to determine the co-efficient of attri-

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tion. By Prof. Wm. Watson. Illustrated. *Four. Assn. Eng. Soc.*, Vol. I., p. 325.

*Valuation of Road Metal and Setts for.* By W. F. Stock. Discusses the salient features to be looked at in selecting road material, and gives results of examinations made with a machine for testing the abrasion resistance of road metal. *Eng. News*, Sept. 22, 1888.

**Pendulum.** See *Engines, Steam, Governors. Theory of.*

**Pendulum, Titan.** A kind of crane which handles and throws automatically large quantities of material, such as loose rock or concrete, to the distance of 100 or 150 feet. Useful in constructing breakwaters. *Sci. Am. Sup.*, Nov. 14, 1885. Also, *Lon. Engineer*, Nov. 13, 1885. Also *Iron*, Nov. 13, 1885.

**Permanent Way.** See *Railroad Track.*

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See *Gas, Natural.*

**Petroleum Engines.** See *Engines, Gas. Engines, Petroleum.*

**Philbrick, Edward Southwick.** A memoir by Albert H. Howland, Desmond Fitz-Gerald and Walter Shepard, Committee of the Boston Society of Civil Engineers, pp. 4. *Four. Assn. Eng. Soc.*, Aug., 1889, Vol. VIII., p. 431.

**Phonograph, The.** An address by Colonel Courand before the Society of Arts, descriptive of the Edison Phonograph. *Four. Soc. of Arts*, Nov. 30, 1888.

See *Gramophone.*



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**St. Leonards-on-Sea.** Gives brief description, with drawing of details of a screw pile promenade pier 900 feet long and 25 feet wide, being built at St. Leonards-on-Sea, England. *Lon. Engineer*, May 11, 1888; *Sci. Am. Sup.*, June 23, 1888.

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See *Concrete Piers. Bridge Piers. Masonry Abutments*.

**Pig Iron.** See *Iron, Pig*.

**Pile Bridges.** See *Bridges, Trestle*.

#### Pile Driver.

**An Account of the Operations of the Gunpowder.** By Samuel R. Probasco. Gives experience with Shaw's patent gunpowder pile-driver. *Trans. A. S. C. E.*, Vol. II., p. 403.

**Missouri Pacific Railway.** Designed for effective work at a greater distance from the road bed than usual. Full detail drawings and description. *Ry. Rev.*, Oct. 25 and Nov. 8, 1890, pp. 636, 666-7.

**Pendulum Pile Driver.** Illustrated description of a machine in which the leaders

**Pile Driver, *Pendulum*, continued.**

are pivoted at the top so that all piles of a trestle bent can be driven without moving the machine. *Eng. Record*, Dec. 5, 1891, p. 11.

***Revolving Hydraulic Pile Driver.*** A heavy truck carries a turn table on which is mounted the pile driver. With this machine piles can be driven in bents 20 ft. apart, the driver being supported on those already driven. Illustrated description. *Eng. Record*, April 4, 1891, p. 290.

***Steam.*** Short illustrated description of a direct acting steam pile driver, whose peculiarity is a fixed piston, the cylinder forming the striking weight. *R. R. & Eng. Jour.*, Feb., 1889; *E. & M. Jour.*, Jan. 5, 1889.

**Pile Driving.**

By E. H. Beckler. Gives forms of records used and experience of the writer on the St. Louis River bridge at Duluth, Minn. *Jour. Assn. Eng. Soc.*, Vol. V., p. 248.

***Cost of.*** Extract from Prof. I. O. Baker's treatise on masonry construction, giving data from actual practice of considerable value. *Eng. News*, Dec. 14, 1889, Vol. XXII., p. 555.

***And Ditch Plant.*** Description of a new and ingenious plant designed by Mr. A. E. Buchanan which has been used on the O. & St. L. Ry. Tables show the extraordinary amount of work performed at one-fourth of the usual cost. Illustrated by an inset plate. No patents. *Eng. News*, Aug. 16, 1890, p. 140.

***By Dynamite.*** Brief account of the successful use of this method. *Eng. News*, March 24, 1883, p. 143.

***Jets.*** See *Dikes*.

***In Sandy Soils.*** An elaborate report on the methods employed on the Mississippi River and elsewhere, comparisons of methods by water-jet and steam hammer, with suggestions for further improvements. By Lt. F. V. Abbot, *Rpt. Chf. of Engrs., U. S. A.*, Vol. II., 1883, p. 1249.

***Service of Hammer Lines.*** A statement showing the service of 79 lines of various make, on the C. M. & St. P. Ry. *Eng. Record*, March 28, 1891, p. 272.

***By Water-Jet and by Hammer.*** Two extended reports by Lt. F. V. Abbot, on this part of the Mississippi River improvement works. Methods and cost given in great detail, and comparisons drawn. *Rpts. Chf. Engrs., U. S. A.*, 1883, Pt. III., p. 1249, and 1884, Pt. II., p. 1505.

See *Water Jet*.

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***In Compressible Soils,*** with experimental tests of Pile Driving and Formulas for Resistance deduced therefrom. Compiled by Gen. Richard Delafield. A memoir of 3; pp. Apply to Chief of Engrs., U. S. Army, Washington.

**Pile Trestle.**

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See *Bridges, Trestles*.

**Piles.**

***Cutting off, Under Water.*** An illustrated description of a saw used for cutting off piles at the draw-bridge of Ruhsort. *Eng. News*, April 2, 1887.

***Destruction of Piles by *Limnoria Lignorum* and *Limnoria Terebrans* in Boston Harbor.*** A special report on piles and piling made under direction of Asst. Henry Manley. Fully illustrated by heliotypes. *Rep. City Engineer*, Boston, Mass., 1888, p. 40.

***Experiments on the Resistance to Horizontal Stress of Timber.*** By J. W. Sande-

**Piles, Experiments, etc., continued.**

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*Formula for.* By John D. Crehore. An attempt to establish a formula for the strength of pillars that yield to bending, rather than to direct crushing. *Van Nos. Eng. Mag.*, Vol. XXI., p. 501. By J. D. Crehore. Gives table of strength. *Van Nos. Eng. Mag.*, Vol. XXIII., p. 60. An article by John D. Crehore. Gives the application of a formula to pillars tested on the government machine at Watertown, Mass. *Van Nos. Eng. Mag.*, Vol. XXIX., p. 129.

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**Pipe, continued.**

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*The Thermodynamics of Certain forms of the Worthington and other Types.*

A discussion of such compound engines as effect the principal parts of the expansion of the steam in the act of exhausting from the high-pressure cylinder into a receiver, from which receiver the low-pressure cylinder is supplied with steam. By Prof. S. W. Robinson. *Trans. A. S. M. E.*, Vol. III., p. 130.

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*Of Sewerage and contaminated water by electrolysis.* See *Sewage Disposal.*

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*The Thermo-Electric Pyrometer of M. C. Chatelier.* A complete description of this instrument, both of the form used in the laboratory and that used in industrial furnaces. By Joseph Struthers. *Sch. Mines Quart.*, January, 1891, pp. 143, 157.

*Use of the Calorimeter for High Temperatures.* By J. C. Hoadley. Describes a successful use and the construction of this instrument. Illustrated. *Trans. A. S. M. E.*, Vol. II., p. 42. See *Platinum* for the specific heat of this metal.

**Quarrying.** See *Blasting. Stone Quarrying.*

**Radiation at Different Temperatures.** Capt. John Ericsson gives results of experiment. Illustrated. *Van. Nos. Eng. Mag.*, Vol. VII., p. 113.

**Rail Fasteners.** See *Railroad Track. Railroad Maintenance.*

**Rail Joints.**

By C. Peter Sandberg, before the Inst. Civ. Engrs. Gives European experience and practice. Gives results of extended tests of different kinds of joints on the Swedish State railways; also proposes tests for rails, and points out some common and fatal errors in the design of cross-sections of rails. The author has been a rail and joint inspector for over 20 years. The article is well illustrated and valuable. Reprinted in *Eng. News*, March 20, 1886.

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*And Splice Bars, Why They Break.* A paper read before the Engrs.' Soc. West. Penn., by M. J. Becker; a careful and valuable study of the subject, with satisfactory conclusions. *Am. Eng.*, Feb. 6, 1885.

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## Rail Sections.

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*A Mean Set of Rail Sections.* A set of designs averaging nearly the proportions of the various sets prepared by the individual members of the committee of Am. Soc. C. E. Most dimensions are either constant or uniformly varying. Full size drawings. *Eng. News*, March 21, 1891, pp. 278-9.

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*Boston & Albany 95-lb. Rail.* Illustrations of section and angle splices, with specifications for chemical composition. *R. R. Gaz.*, March 13, 1891, pp. 176-7. *Eng. News*, April 4, 1891, pp. 330-1.

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*And Flange Wear.* An able discussion of a paper, by M. N. Forney, Secretary Master Car-Builders' Association, taking exceptions to conclusions there reached. Illustrated. *R. R. Gaz.*, March 27, 1885.

*Heads, Form of the Under Side of.* Gives a number of the illustrations of worn rail and discusses the causes of the wearing. *Eng. News*, Feb. 26, 1887.

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*Proposed.* Paper by Robert W. Hunt, Chicago, giving details of proposed rail sections, attention being paid to facility of manufacture as well as to meet the demands of use. *Proc. A. I. M. E.*, New York meeting, Feb., 1889.

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**Rails.**

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*Single Rail.* Gives a historical review of the subject, and describes the road constructed on the Lartigue System at Westminster, with cost. *Sci. Am. Sup.*, March 12, 1887.

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See *Railroads, Rack. Cable. Railroad Systems.*

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*Cause of the Formation of, at the Mouths of Rivers, as Shown in the Examination of the Connecticut River.* By Gen. T. G. Ellis. Gives results of the study of changes going on at the mouth of the Connecticut River. Contains information relative to the water-shed and flow of Connecticut River, and of the tidal currents of Long Island Sound. *Trans. A. S. C. E.*, Vol. II., p. 313.

*At the Mouths of Tidal Estuaries.* Valuable paper read by William H. Wheeler, Feb. 4, 1890. Folding plate shows plans and sections of different bars. *Proc. Inst. C. E.*, Vol. C., paper No. 2,438, pp. 116-43; discussion, pp. 144-78; correspondence, pp. 176-216.

See *River Hydraulics.*

**River Basins.**

*Basin and Regimen of the Mississippi.* By C. M. Woodward. Gives much information relating to the river and its action. *Van Nos. Eng. Mag.*, Vol. XXVII., p. 18.

*The Illinois River Basin and Its Relation to Sanitary Engineering.* A paper by L. E. Cooley, C. E., discussing the conditions existing at present in the Illinois River basin. *Prelim. Rep. Ill. State Board of Health*, 1889, pp. 49-81.

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*Account of Recent*, in Holland. These measurements show the inaccuracy of loaded tubes in ordinary rivers, the results they give being always too large, sometimes by 16 per cent. Various other interesting results regarding accuracy of methods of gauging. *Wochenschrift d. Oester. Ing. u. Arch. V.*, 1886, pp. 233-239, 243-247.

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See *River Hydraulics.*

**River Hydraulics.**

*Determination of the Flood Discharge of Rivers and the Back Water caused by Contraction.* By Wm. R. Hutton; with discussion by Theo. R. Ellis and Robt. E. McMath. This is the *Elmira Crossing case*, between the Lackawanna and Erie roads. The discussion mostly valuable in showing the worthlessness of all formulas for such uses. *Trans. A. S. C. E.*, Vol. XI. (1883), p. 211. Same case and formulas discussed by Gen. Q. A. Gillmore in *Van Nos. Eng. Mag.*, Vol. XXVI., June, 1882, p. 411.

See *Hydraulics.*

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A reply to the above paper. By J. B. Eads, *Van Nos. Eng. Mag.*, Vol. XX., p. 154.

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*Physics and Hydraulics of the Mississippi.* A reply to criticism made by Dr. Hagen, by Gen. Humphreys and Gen. Abbot. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 1.

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By W. S. Chaplin. Gives illustrated descriptions of some of the methods employed in Japan. *Van Nos. Eng. Mag.*, Vol. XIX., p. 129.

Methods pursued on the Missouri River, with many cuts showing mattresses in process of construction, mattress boats, etc. *Rep. Chf. of Engrs.*, 1883, Vol. II., p. 1297.

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## River Improvement, continued.

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Converting the River Main, between Frankfort and Mayence, into a slack-water navigation, by means of five movable dams, locks, channels for rafts and other works. To be finished Oct. 1, 1886, at a cost of about \$1,375,000. *Zeitschrift. d. V. D. Ing.*, Oct. 25, 1884.

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**Danube:** two lectures by Gustav Wex, Chief Director of the work. Translated and issued by the Engr. Dept., U. S. A., as two separate pamphlets of 25 pp. and 60 pp. respectively.

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**River Improvement, In France, continued.**

system of movable dams. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 339. By Wm. Watson. An illustrated description of the Chanoine system of falling gates. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 458. By Wm Watson. Illustrated description of the Chanoine movable dam at Paris. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 481.

*At Harlem, Mo., and Kansas City, Mo.* An account of recent improvements, cost, methods employed, including experience sinking piles by water jet. etc. Fully illustrated. Details of nozzle used in pile-sinking given. *Report of Missouri River Commission. Chief of Eng. Rep.*, 1889. Appendix WW. p. 2785.

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*Cut-offs.* By C. G. Forshey. Gives particulars of Shreve's or Red River, Racouri, Terrapin Neck, and Palmyra cut-offs. *Trans. A. S. C. E.*, Vol. V., p. 317. See *Mississippi River*.

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*Protection of the Lower Mississippi Valley from Overflow.* Condensed reprint of a paper by Prof. J. B. Johnson, read in 1884. *Eng. News*, April 19, 1890, Vol. XXIII., p. 364.

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*New Channel from Rotterdam to the North Sea.* From the German. A fine account of this important work, with maps, plans, sections of jetties, etc. Consists of the cutting of a channel three miles long through low lands and sand dunes; the closing of the old river; the construction of two parallel jetties far into the sea; the regulation of the river above the new cut; the construction of a large dyke ten miles long, and the construction of a canal with locks. All described in *Eng. News.*, Aug. 28, 1886.

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*Nile.* See *Nile*.

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*By Harrows.* Bikoff's system. *Ingenieur*, St. Petersburg, Vol. IV., 1887, p. 372. An abstract of the method in *Proc. Inst. C. E.*, 1884, Vol. LXXXVI., p. 393.

*By Propeller Sluicing.* An account of sand-bar removal on the Columbia River, Oregon, by means of a screw propeller, commercially successful. *Trans. Inst. C. E.* Vol. LXXXIII., p. 386.

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*St. John's, (Fla.)* Abstract of a report to the Municipal Board of Jacksonville, Fla. By J. B. Eads. *Van Nos. Eng. Mag.*, Vol. XVIII., p. 49.

*Sulla sistemazione dei fiumi e torrenti della Carinzia.* 9 tables and 2 handsome folding plates showing the details of this work. *Giornale del Genio Civile*, Anno XXVIII., April, 1890, pp. 169-99.

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*Tiber, Discharge and Regulation of the.* By T. Montanari. An examination of the measurements made at different times, with a view to the construction of a new scale for the river; also discusses mean velocities, rainfalls, etc. *Van Nos. Eng. Mag.*, Vol. XXIX., p. 501.

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*In the United States.* [The valuable paper by Chas. C. Brown, read before the Eng. Club of St. Louis and published in *Four. Assn. Eng. Soc.*, Oct., 1890, is reprinted in *Eng. News*, March 21, 1891, pp. 283-4, *et seq.*

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## Rivers.

*By Edward Eastan.* Contains review of ancient water-works and treats of the English rivers. Advocates a local government board for dealing with every watershed in England. *Van Nos. Eng. Mag.*, Vol. XIX., p. 345.

*By W. H. Wheeler.* Treats of the rivers in the Eastern Midland district of England, the Withan, Willand, Ouse, etc.; also of floods of their remedy. *Van Nos. Eng. Mag.*, Vol. XXVII., p. 281.

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*Canalisation of.* See *Canals.* *River Improvement.*

*And Canals.* A short description of the more recent methods of transport on rivers and canals, and details of their employment in Germany. *Van Nos. Eng. Mag.*, Vol. XXVIII, p. 295.

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*Conservancy.* By J. C. Hawkshaw. Illustrated by drainage administration in Holland. *Van Nos. Eng. Mag.*, Vol. XXIII., p. 250.

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*Mississippi; See Rivers, The Mississippi River, below.*

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## 406 STRENGTH OF SLATES—SUBAQUEOUS FOUNDATIONS.

### Strength of Slates.

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- Milwaukee, The New Michigan Intake of the.* 3000 feet of tunnel, and 5000 feet of 60 inch pipe laid in a trench on the lake bottom, reaching out to 60 feet of water. Plan and profile. *Eng. News*, Oct. 25, 1890, pp. 366-7.
- Minneapolis Pumps.* Gives brief illustrated description of the pumps in use at the Minneapolis water works. *Eng. & Build. Rec.*, September 15, 1888.
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- Nagpur, India.* Gives a general description of the works for supplying Nagpur, India, with 15 gallons per capita per diem by a gravity system: also contains much information in regard to rainfall, evaporation, discharge and consump-



**Water Works, Nagpur, India, continued.**

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Condensed description taken from *Le Genie Civil*, of the collecting galleries, conduits, aqueducts, siphons, gate houses, etc. Illus. *Eng. & Build Rec.*, Dec. 6, 13, 1890.

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*Prague.* Description of the Prague water-works machinery with two-page plate and cuts showing details. *Lon. Eng.*, Sept. 9, *et seq.*, 1887.

*Putnam, Conn.* Brief description of the system, capacity 1,000,000 galls. in 24 hours, 2½ miles of 10-inch pipe leading to a wrought-iron stand-pipe. *San. Eng.*, April 9, 1887.

*Quebec.* Illustrated description. *Eng. News*, May 9, 30, 1878.

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**St. Louis.**

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**Water Works, continued.**

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*Stratford-on-Avon.* Full detail drawings and description. Gravitation system, with reservoir. Town of 8,000 inhabitants. *Lon. Engineer*, November 27, 1885.

*Tables for Power of Compound Pumping Engines.* See *Pumping Engines*.

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### Water-Works Pressure Records.

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**Wheels and Axles.** See *Axles.*

**Wheels and Rails.**

*Cylindrical Wheels and Flat-Topped Rails.* Abstract of a paper read by Mr. Don. J. Whittemore, Civ. Engr., C., M. & St. P. Ry., before Am. Soc. Civ. Engrs. In the nature of a discussion of the recent report of the "Committee on the Proper Relation to Each Other of the Sections of Railway Wheels and Rails." *Eng. News*, Feb. 9, 1889, et seq.

*Cylindrical Wheels and Flat-Topped Rails.* Paper by D. J. Whittemore. Chf. Engr. C., M. & St. P. Ry., at Jan. 16 meeting, A. S. C. E. *R. R. Gaz.*, Jan. 25, 1889.

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A table giving the relation between the velocity and the pressure at different temperatures. *Am. Eng.*, May 1, 1885.

An article giving formulæ and tables for wind pressure. *Van Nos. Eng. Mag.*, Vol. XXVI., p. 49.

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Brief article calling attention to actual wind pressure of from 40.0 to 65.2 lbs per sq. ft., and observed velocities of from 57 to 78 miles per hour. *Lon. Eng.*, March 14, 1890, p. 333.

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*An Examination into the Method of Determining.* By F. Collingwood. Discusses a number of the formulæ in common use and points out some of their errors; also gives tables of pressures computed by different formulæ for comparison. *Van Nos. Eng. Mag.*, Vol. XXV., p. 242.

Extract from evidence of Wm. Pale, before the Tay Bridge Commission. *Van Nos. Eng. Mag.*, Vol. XXIII., p. 163.



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*And the Measurement of Wind Velocities.* An article by Asst. Prof. C. F. Marvin, U. S. Sig. Service, giving some experiments on Wind Pressure made on Mt. Washington, and discussing reduction formulas for anemometers. *Eng. News*, Dec. 13, 1890, pp. 525-1.

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*Velocity and Pressure.* A table showing the average monthly movement of, in miles per hour at a number of cities; also a table showing the relation between velocity and pressure. *Building*, April 2, 1887.

See *Atmosphere. Air Resistance. Chimneys. Lighthouses.*

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A formula giving the relation between the diameter in inches and the gauge, number (American standard) and the use of this formula in electrical designing. By Carl Hering. *Elec. Eng.*, (N. Y.), April, 1886.

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*Permanent Elongation in.* See *Metals.*

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*Chart showing properties of all wire gauges in use.* Compiled by S. S. Wheeler. The most complete exposition of the subject yet made. *Elec. World*, Nov. 12, 1887.

*Report of the Committee of the National Electric Light Association at Philadelphia meeting*, February, 1887. Containing probably the best recommendations as to a standard gauge that have yet been made. *Elec. World*, Feb. 26, 1887; also in *Electrician & Elec. Eng.* for March.

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Gives description of the process of manufacturing, from drawing the wire to twisting the rope. *Sci. Am. Sup.*, July 2, 1887.

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**The Locked Coil.** A new style of wire rope, being smooth on the outside like a round rod, and the wires made of special shapes so as to interlock with each other, thus preventing any wire from moving from its place. Illustrated. *Iron*, Sept. 18, 1885.

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**Wiring Chart.** Diagram for use for calculating the length of conductor necessary to give a certain drop in voltage. By Thos. J. Fay. *Elec. World*, Aug. 1, 1891, p. 79. *Eng. News*, Sept. 12, 1891, p. 242. *Elec. Eng.*, Oct. 8, 1890.

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**Wire Ropeway.** See *Cements of the Gate, etc.*

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**Wood.**

**Expansion of, by Absorption of Moisture** in the direction of the fibres. Paper by Prof. DeVolson Wood, giving results of experiments. *Trans. A. S. M. E.*, Vol. X., 1889.

**Fluctuations of Moisture in Wood during Seasoning.** Details of experiments made to observe the variation in moisture in different kinds of wood, and learn the months during which the greatest amount of seasoning takes place. *Eng. News*, April 2 and 16.

**Preservation of.** See *Timber*.

**Preserved Under Water.** Recent discovery of remains of old Roman bridge piers in river Trent, the oaken timbers being in good preservation. *Lon. Engineer*, Nov. 7, 1884.

See *Timber*.

**Wood Pavements.** See *Pavements*.

**Wood Pulp.**

**Some of its Peculiarities.** By M. L. Deering, Cleveland. Describes methods used in his own factory and the difficulty to be overcome. With discussion. *Four. Assn. Eng. Soc.*, Vol. V., p. 444.

**Vulcanization.** By M. L. Deering. Describes a new method of treating fibrous material. *Four. Assn. Eng. Soc.*, Feb., 1888, pp. 52-55.

**Wood-Working Machinery** on exhibition at World's Fair, New Orleans. *Mfr. & Build.*, March, 1885.

A description of the recent improvements in wood-working machinery in England, and their application to cheapening the cost of pattern-making. Mr. Geo. Richards. *Lon. Eng.*, Feb. 13, 1885.

**Wooden Beams.**

**Transverse Strength of,** being a new formula by R. F. Hartford, C. E., which harmonizes with latest experiments, including those of Lanza, Rodman, Haslett, Graham; Smith and others. *Am. Eng.*, Dec. 12, 1884.

**Transverse Strength of.** By Prof. Lanza. Gives results of experiments on large beams. *Four. Assn. Eng. Soc.*, p. 133, Vol. II.

See *Beams*.

**Wooden Columns.**

**Full Size.** Strength of, as tested by Prof. Lanza on the Watertown Arsenal Machine, for the Boston Manufacturers' Mutual Fire Insurance Co., in 1882. Probably the most extensive and satisfactory set of tests of wooden columns

**Wooden Columns, Full size, continued.**

ever made. A supplement of 50 pp. and 56 cuts, with details of tests, appended to *Trans. Soc. Arts*, Boston, 1881-2.

*vs. Cast Iron Posts.* Brief article describing behavior of pitch-pine columns during a severe fire in a large warehouse in London. Columns burned on outside, but supported their load. *Mechanics*, August, 1889, Vol. XI., p. 193.

**Woodite.** By Sir Edward Reed. Discusses the use of a new structural material, the base of which is rubber. It appears to be coming into general use in many ways. *Sci. Am. Sup.*, March 31, 1888.

**Woods.**

*American. Modulus of Elasticity as Determined by Vibrations.* By M. C. Ihlseng. Gives details of method employed and table of values of the modulus of elasticity. *Van Nos. Eng. Mag.*, Vol. XIX., p. 8.

*Cuban.* By Esteban D. Estroda. An investigation of the strength and other properties of Cuban woods used in engineering construction. *Van. Nos. Eng. Mag.*, Vol. XXIX., pp. 417 and 443.

*Michigan. The Strength of.* A paper read before the Michigan Engineering Society by Prof. R. C. Carpenter, January, 1889. *Am. Eng.*, March 6, 1889.

*Of Nicaragua. An Investigation of the Strength* and other properties of some of the Nicaragua woods used in engineering construction and in the arts, conducted at Cornell University. By Rufus Flint. Thirty-three kinds examined. A valuable study. *Sch. Mines Quart.*, Oct., 1887, p. 633.

See *Timber*.

**World's Columbian Exposition.** See *Exposition*.

**Work Developed in Rail and Girder Rolling.** Experiments made in St. Petersburg. *Proc. Inst. C. E.*, Vol. LXXXI., p. 414.

**Working Loads.** Natural working loads for building materials and structures, adopted by the Austrian Association of Engineers and Architects. *Eng. & Build. Rec.* Dec. 14, 1889, Vol. XXI., p. 25.

**Yard.** *On the Relation of the Yard to the Metre.* A report to the U. S. Coast and Geodetic Survey. By O. H. Tittmann, assistant in charge of weights and measures. *U. S. C. and G. Survey Bulletin No. 9*, June 15, 1889.

**Yacht, Grace Darling.** Gives a brief description, with two page plate, showing longitudinal section, deck plan and cabin plan of the steam yacht "Grace Darling." Length over all, 157 ft., breadth, 19½ ft.; depth, 11 ft.; draught 8 ft.; tonnage, 239 tons; engines, quadruple expansion; cylinders, 10 in., 14 in., 20 in. and 28 in. diameter, with 20 in. stroke; 160 revolutions per minute; 360 horse-power, with boiler pressure of 180 lbs. *Lon. Engineer*, March 16, 1888.

**Yachts, Racing and Cruising.** Remarks on the length, beam and sail area of racing and cruising yachts, with suggestions for defining cruisers and for regulating races. Gives tables showing leading dimensions and antics of British and American yachts. *Lon. Eng.*, Nov. 25, *et seq.*, 1887.

**Z-Bars.** See *Columns*.

**Zinc.** Its unfitness for standards of length from its slow response to changes in temperature. In other words, its length is not truly indicated by its temperature when the temperature changes rapidly, as in field observations. Prof. Papers Corps of Engrs. U. S. A., No. 24. Triangulation of U. S. Lake Survey, p. 860.

*In Boilers.* See *Boilers, Marine*.

**Zinc and Lead.** *Production of in 1888.* See *Lead*.



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